WHMIS
RIGHT TO KNOW

LEGISLATION

GOVERNMENT
INDUSTRY
LABOUR

Participant Guide

June, 1988

MODULE ONE B

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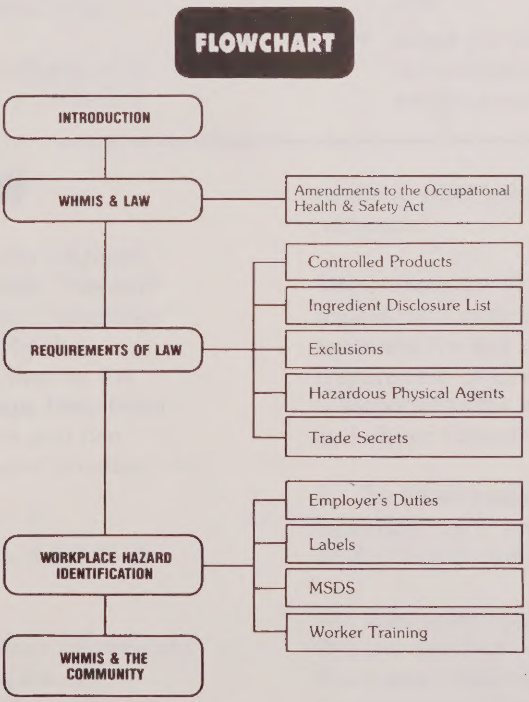
TERMINAL OBJECTIVE:

The participants will have sufficient knowledge of the amendments to the Occupational Health and Safety Act to enable them to ensure that suppliers and employers fulfill their duties and responsibilities to WHMIS under the Act

PERFORMANCE OBJECTIVES:

The participants shall:

1) Explain how WHMIS is implemented in law.
2) Explain how the law defines a controlled product
3) Explain how the law defines hazardous ingredients.
4) Identify the exclusions.
5) Identify what is meant by a hazardous physical agent.
6) Explain the reasons for creating the Hazardous Materials Information Review Act
7) Identify how appeals under the Hazardous Materials Information Review Act can be handled.
8) Identify the additional employer duties created by WHMIS.
9) Explain the requirements for labeling.
10) Explain the requirements for Material Safety Data Sheets.



LEGISLATION

W.H.M.I.S. These are the initials of a new workplace health and safety information system. The initials stand for **Workplace Hazardous Materials Information System,** but the idea they express is also known as the **Right to Know.** It is a Canada-wide system to provide employers and workers with information about the hazardous materials they work with on the job to protect their health and safety. WHMIS is the outcome of four years of consultation and negotiations among federal and provincial governments, industry and organized labour. Its rules apply in every province and territory, as well as workplaces covered by federal law.

WHMIS gives everyone in the workplace the right to know about the hazards of materials used in the workplace. It does this by means of:

- warning labels on containers of hazardous materials;
- separate safety data sheets providing further detailed information (known as Material Safety Data Sheets or MSDS);
- worker training on how to use this information.

This information module describes:

- **how** the WHMIS idea was converted into law for the benefit of Ontario workers: and
- **what** the law requires both from suppliers of hazardous materials and from employers whose workplaces use them

WHMIS AND THE LAW

To make WHMIS a practical reality, changes were needed in the laws of Canada. This was achieved by means of two separate "packages" of law amendments, one passed by the parliament of Canada, and the other by the Ontario legislature. The same steps have been taken by the other nine provinces and two territories to make WHMIS a "pan-Canadian" or Canada-wide progam.

The federal law package was called Bill C-70 and it has three purposes:

1. To apply the labelling and other information requirements of WHMIS to suppliers of hazardous materials and to establish rules for deciding what substances are "hazardous materials".

The *Hazardous Products Act* and its Regulations (called the Controlled Products Regulations) were amended for this purpose. The federal Department of Consumer and Corporate Affairs is responsible for this Act, but it is administered by Labour Canada.

2. To allow manufacturers to protect their legitimate trade secrets without endangering worker health and safety.

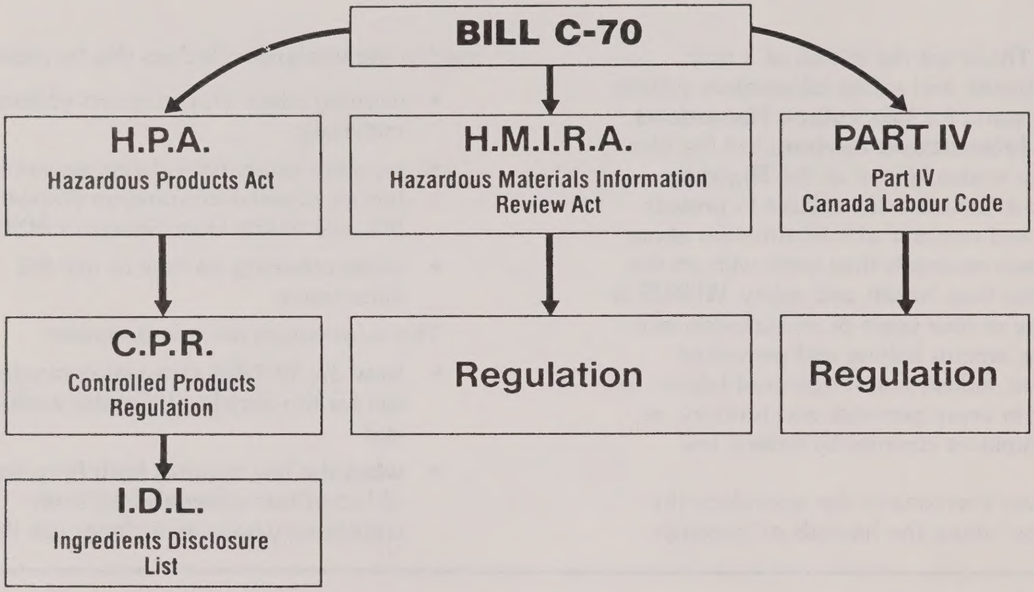
The *Hazardous Materials Information Review Act* is a new law created to perform this function. It is administered by the Department of Consumer and Corporate Affairs.

3. To apply WHMIS to workplaces under the federal labour jurisdiction by amending the health and safety section of the *Canada Labour Code*.

The *Canada Labour Code* is managed by Labour Canada, and does not apply to Ontario workplaces unless they come under the federal labour jurisdiction. Airlines, railways, banks, and other similar national services are examples of workplaces in the federal labour jurisdiction.

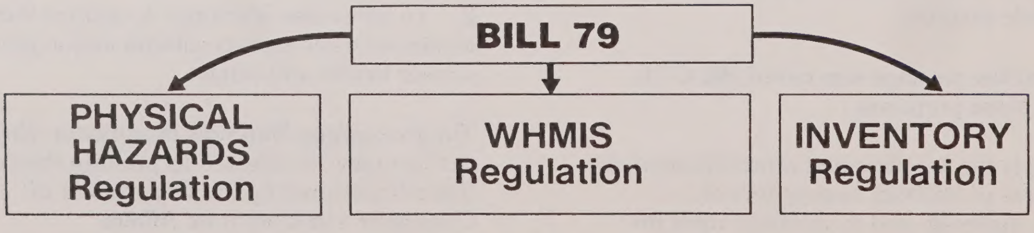
Bill C-70 was passed on June 30, 1987, but takes effect on October 31, 1988. The sixteen month waiting period allows suppliers time to prepare proper WHMIS labels and Material Safety Data Sheets (MSDS).

Federal:



The **provincial law package**—for Ontario—was contained in Bill B-79. It applies WHMIS to non-federal workplaces in Ontario by amending the *Occupational Health and Safety Act* (OHS Act) and by adding special WHMIS Regulations to it. These changes were also passed in June, 1987, and come into effect on October 31, 1988. All the provinces and territories of Canada have passed similar bills in order to apply the WHMIS program consistently right across the country. The Ontario OHS Act is administered by the Ontario Ministry of Labour.

Ontario:



WHAT THE LAW SAYS

This section describes the meaning of the WHMIS progam in four parts:

1. What Is A Hazardous Material?
2. How Trade Secrets Are Protected
3. Identifying Workplace Hazards
4. Getting Information To Workers.

1. What Is A Hazardous Material?

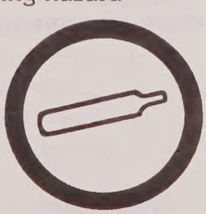
There are two correct answers to this question. One answer affects **suppliers** of hazardous materials. The other applies to **workplaces.**

Suppliers

Suppliers are importers, manufacturers or any sellers of hazardous materials for use in a Canadian workplace. The *Hazardous Products Act* defines a hazardous material as a controlled product, or

> any product, material or substance specified by Regulations made by the Governor-in-Council (meaning the Cabinet) and **included in any of the classes in Schedule II of the Act.**

There are six classes of hazards. They are: compressed gas, flammable and combustible material, oxidizing material, poisonous and infectious material (which contains three separate sub-classes), corrosive material and dangerously reactive material. Each of the classes is represented by one of the following hazard symbols:



CLASS A
COMPRESSED GAS:

A substance that at room temperature (20° C) is in the gaseous state and kept under pressure. Example: acetylene and oxygen are gases at room temperature.

CLASS B
FLAMMABLE AND COMBUSTIBLE MATERIAL:

A solid, liquid or gas that will ignite and continue to burn if exposed to a flame. Example: gasoline will ignite if one holds a flame close to the liquid but water will not.

Combustible liquids have a flash point greater than 37.8° C whereas flammable liquids have a flash point below 37.8° C.

This class includes:
1. flammable gas
2. flammable liquid
3. combustible liquid
4. flammable solid
5. flammable aerosol
6. reactive flammable material.

CLASS C
OXIDIZING MATERIAL:

This is a substance that will cause another substance to burn. Example: chromic acid, when poured onto paper, will cause the paper to burn.

CLASS D
POISONOUS AND INFECTIOUS MATERIAL:

This class of material includes:

1. Materials causing immediate and serious toxic effects.

These are materials which cause harmful effects, including death, within a short period of time after exposure.

CLASS D (continued)

e.g. correction fluid

2. Materials causing other toxic effects.

These are materials which cause harmful effects days, months or years after one or more exposures. Materials which can cause cancer are included here.

3. Biohazardous infectious material.

An organism or its toxins that may cause serious infectious disease. Examples: Anthrax (meat handling and tanning), bacteria-laden cotton dust (cotton processing).

CLASS E
CORROSIVE MATERIAL:

A substance that will erode steel or aluminium or destroy animal tissues. Example: chromic acid.

CLASS F
DANGEROUSLY REACTIVE MATERIAL:

A material which will react with water to produce a poisonous gas or which will undergo a reaction if the container is heated, pressurized or agitated. Example: benzoyl peroxide will decompose and explode if it is heated or dropped.

Criteria for determining if a material falls into these classes are specified in the Controlled Products Regulations. The hazard criteria apply to both pure substances and mixtures.

There is no list of controlled products, but any product which includes any of the features of one or more of the six classes is a controlled product. Where there is any doubt about a particular material, the Controlled Products Regulations prescribe complex testing procedures which give decisive answers.

Ingredient Disclosure List

The **Ingredient Disclosure List** is a list of more than 1,700 chemical ingredients commonly found in the controlled product classes. Stated with each ingredient is a volume concentration figure. If a controlled product contains that ingredient in any concentration above the stated figure, then the ingredient must be named and its concentation level shown on the Material Safety Data Sheet (MSDS) for that controlled product. The ingredient must be listed in any case where it makes up more than 1 per cent of the total volume of the product, unless the ingredients are carcinogens, reproductive hazards or lung sensitizers, then they must be disclosed if they make up more than 0.1 per cent of the concentration.

Example:
The well known hazardous material, TotaSolve, is widely used in the production of rubber duckies. TotaSolve is 25 per cent styrene, a substance appearing on the Ingredients Disclosure List. Because styrene makes up more than 0.1 per cent of TotaSolve and is a carcinogen, the MSDS for TotaSolve must name styrene and show its concentration level, 25 per cent, for the information of any person in the workplace who needs or wishes to know the chemical composition of TotaSolve.

Exclusions:

Certain hazardous materials are excluded from the Hazardous Products Act—and therefore are exempted from the WHIMS rules on labelling and MSDS—because they are already covered under four other laws:

- the Explosives Act;
- the Food and Drug Act;
- the Pest Control Products Act; and
- the Atomic Energy Control Act.

Hazardous wastes, consumer products, wood or wood products, tobacco or tobacco products and manufactured articles are also excluded from WHMIS.

Amendments:

The Cabinet may, at any time, add an ingredient or take one away from the Ingredient Disclosure List or amend Schedule II of the Act which describes the six classes of controlled products. But before it does so, it must first consult with organizations representing workers, suppliers, employers and the Ministers in each province or territory who are in charge of WHMIS. In other words, nobody will be in the dark about changes in the laws or regulations which might affect the workers' right to know.

For an employer who runs a non-federal workplace in Ontario, The Right To Know includes more than **controlled products.** Amendments made by Bill -79 to the *Occupational Health and Safety Act* include the WHMIS Regulations. These Regulations describe **hazardous materials** as controlled products. A separate regulation will define hazardous physical agents. Noise, vibration and radiation are examples of hazardous physical agents.

Therefore, the requirements for labelling, MSDS and worker training in Ontario workplaces apply to a broader group of hazards including both "hazardous materials" and "hazardous physical agents".

2. How Trade Secrets Are Protected

One problem faced by WHMIS was the conflict between the workers' Right to Know the details about hazardous materials in the workplace and the suppliers' or employers' to keep confidential business information—or trade secrets—out of the hands of competing suppliers. Obviously, trade secrets could become known to competitors by someone copying the ingredients list from a MSDS for the product in question. On the other hand, failure to list those ingredients could create a risk for workers.

In the end, negotiators for organized labour, industry and government found a way protect legitimate trade secrets without risk to the safety or health of workers. The *Hazardous Materials Information Review Act* (HMIRA) is a new law passed for this purpose, in the package of federal law amendments called Bill C-70. The producer of a hazardous material may ask permission not to reveal certain ingredients, their concentrations or name of supplier on the grounds that this information needs to be guarded as a trade secret. An impartial review commission, under the HMIRA, will examine the claim and judge whether a legitimate trade secret really is involved. Workers or other affected parties participate in the process to argue for or against the claim.

If the Commission allows the claim, it will exempt the supplier from putting the trade information on WHMIS labels or MSDS for that product. Anyone who is dissatisfied with a decision by the Commission may appeal it through another procedure under the HMIRA.

Where the trade secret claim involves a product used by an Ontario employer, it will be dealt with under a similar system included in the Ontario OHS Act.

3. Identifying Workplace Hazards

The employer is now required by this amended Ontario Occupational Health and Safety Act (OHS Act) to identify hazardous materials in the workplace by:

- preparing a workplace inventory,

  and

- performing assessments on hazardous materials produced in the workplace and used in the workplace.

The **Workplace Inventory** is a list of all hazardous materials present in the workplace—including all hazardous physical agents. The employer must prepare and maintain this inventory after consultation with the joint health and safety committee in the workplace or with the worker health and safety representative, if any. In a workplace with neither a committee or a representative, workers may select one of their number to represent them.

Copies of the Inventory must be given to the joint health and safety committee or worker representative and must be made available to the workers as well.

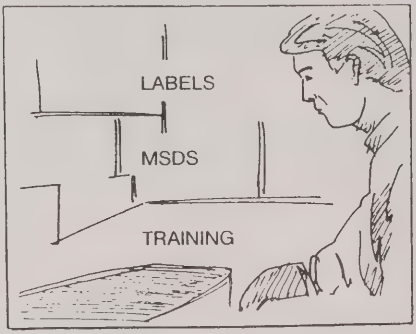
Assessments are required by the OHS Act for all biological, chemical and physical agents actually **produced** in the workplace to determine whether they are hazardous materials. The employer is responsible for the assessment, but must first consult with the worker representative or joint health and safety committee and then furnish them with copies of the finished assessment.

The rules for performance of assessments are the same as those which apply to suppliers under the Controlled Products Regulations.

4. Getting Information To Workers

WHMIS puts vital information about hazardous materials into workers' hands. It does so by means of an information delivery system which has three parts:

1) Labels,
2) Material Safety Data Sheets (MSDS), and
3) Worker Training.



Employers are responsible for seeing that every container of hazardous material entering the workplace has the proper label attached, that there is an up-to-date MSDS for each product available for everyone in the workplace to see, and that workers receive training in the meaning of this information and how to use it to protect their health and safety on the job.

The actual provisions of the law on information delivery may be found in the Controlled Products Regulations of the federal *Hazardous Products Act* and in the WHMIS regulations of the Ontario *OHS Act*.

1) Labels

Hazardous materials must be easily identifiable to workers on the job. This is the purpose of the WHMIS label which is the first hazard warning workers are likely to see.

In most cases, this label will be a **supplier label**—the label placed on a container of hazardous material by the supplier before shipping. Or, the supplier label may be included with the shipment and placed on the containers by the receiver when the shipment arrives at the

workplace where it will be used. In other cases, the label may be a **workplace label,** the label placed on a hazardous material which has been produced in the workplace. **Workplace labels** are also used on a hazardous material which has been transferred from its original container into a smaller container after arrival. Both **supplier labels** and **workplace labels** are required to present certain kinds of information for the benefit of workers who use the materials or come into contact with them on the job.

Supplier Label:

Those who supply a hazardous material, either by importing it or producing it or selling it in Canada, must affix a **supplier label** to the container. Where containers are crated inside a larger package for shipping, the supplier may supply the labels separately for the employer to attach once the shipment is received and broken down.

The receiving employer must make sure the **supplier labels** are in place, and the labels must meet the specifications of WHMIS. These requirements include use of distinctive WHMIS border around the **supplier label,** the proper hazard symbol or symbols, and certain types of information presented in both English and French.

A **supplier label** contains seven separate pieces of information:

i) *product identifier* (the name of the material);

ii) *supplier identifier* (the name of the supplier of the material);

iii) *MSDS statement* (a statement which says that a material safety data sheet for that material is available in the workplace);

iv) *hazard symbol* (one or more of the 8 WHMIS hazard symbols) which apply to the material;

v) *risk phrases* (brief description of the hazard and the effects of harmful exposure on the body);

vi) *precautionary measures* (brief instructions for safe use of the material); and

vii) *first-aid measures* (how to treat persons who have been exposed to the material).

The employer is responsible for seeing **supplier labels** are not removed or altered or destroyed and that the material is not used without the correct label attached.

Workplace Label:

These labels must be placed on hazardous materials produced in the workplace or on material decanted from its original container into another container at the workplace. But the new container need not be labelled if it will be used only by the person who filled it, and during the same shift. The **workplace label** contains less information than the supplier label. It need not display a hazard symbol and is required to give only three of the seven kinds of information:

i) product identifier,

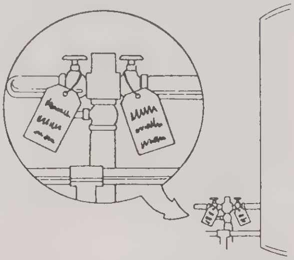
ii) safe handling instructions, and

iii) MSDS statement.

Materials produced in the workplace which are being readied for sale do not need **workplace labels** because they will be covered by **supplier labels** when they are shipped.

Piping systems used to transfer a hazardous material must use colour-coded identifiers or tags or placards or other suitable means to let workers know what is contained in the pipes. Similar rules apply to bulk hazardous material—

such as powder or granules—which is not kept in a container. The information which would otherwise appear on a workplace label must be posted by the employer in a conspicuous spot near the material and in a form large enough to be easily read by workers.



Labelling rules are also less complicated for hazardous materials shipped from a laboratory supply house for use in a workplace which is a laboratory—provided it is in containers weighing less than 10 kilograms.

A hazardous material undergoing tests or analysis in a laboratory must be clearly identified by a label or sign on or near the container.

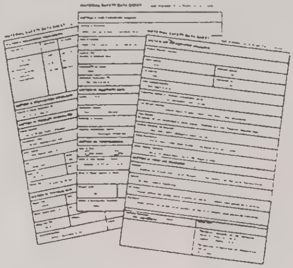
The WHMIS rules for both **supplier labels** and **workplace labels,** as well as exemptions and special provisions, are described in greater detail in Module 2, Information Delivery.)

2) Material Safety Data Sheets (MSDS)

The MSDS is the second level of the Right to Know. The WHMIS label provides vital warning information to those on the spot, but the MSDS contains additional details which will be important in handling emergencies or clean-ups, or in designing controls for the safe use of the hazardous material without using worker exposure.

Federal law requires the supplier of a controlled product to provide a MSDS for it. Ontario law requires the employer to have a MSDS available for every hazardous material in the workplace. The MSDS contents are spelled out by both federal and provincial regulations.

Ontario employers must have a MSDS for each hazardous material available for examination by workers in the workplace, as well as by worker representatives and members of the joint health and safety committee. The MSDS must be in English and in other main working languages of the workplace if required. If the MSDS takes the form of a computer display rather than a paper copy, the employer must make sure all workers know how to use the computer in order to read the MSDS.



The MSDS contains 9 different kinds of information (plus any other relevant information of which the employer is—or ought to be—aware):

i) *hazardous ingredients*: names, concentrations and other details of known hazardous ingredients, and of other ingredients which the employer or supplier suspects may be hazardous, or whose dangers to the body are unknown;

ii) *preparation information:* name and telephone number of the person who prepared the MSDS and the date of preparation;

iii) *product information*: name and address of the producer and/or supplier, must be the same as shown on the supplier label;

iv) *physical data*: properties of the material, such as physical state (gas, solid or liquid), smell and appearance;

v) *fire or explosion hazard*: flashpoint of the material and other similar data;

vi) *reactivity data*: details of stability and reactions to conditions such as light, heat, moisture, vibration, etc.

vii) *toxicological properties*: adverse health effects from exposure;

viii) *preventive measures*: instructions for safe use, handling and storage; and

ix) *first-aid measures*: instructions for initial treatment of those exposed to the material.

Every MSDS must be current and up-to-date—meaning less than three years old. It must be revised within 90 days of any new hazard information becoming known about the material.

The employer is responsible for obtaining up-dated versions from the supplier, if that proves impossible, for adding any new information to the existing MSDS—or preparing his/her own MSDS. This employer MSDS must never supply less information than appears on the supplier MSDS.

An employer MSDS is most likely to be prepared in connection with a material produced in that employer's workplace. This does not include fugitive emissions, amounts of the material which escape from the process to the workplace in the form of vapour, gas, etc.

More detail about the Material Safety Data Sheet is contained in Module 2, Information Delivery.

3) Worker Training

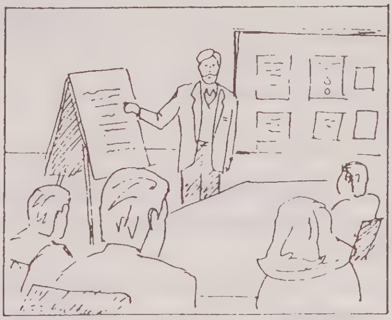
The final step in the WHMIS system is worker training or education. Training provides the knowledge needed by the individual to exercise the right to know about hazardous materials in the workplace.

Employer Duties:

Employers have the duty under the law to deliver worker training. The OHS Act directs employers to instruct workers and acquaint them with workplace hazards. With the addition of WHMIS, employers have the further duty to instruct and train workers who are likely to be exposed to hazardous materials and/or hazardous physical agents, like noise or radiation.

Consultation, Up-date and Review:

Worker training must deal with the actual hazardous materials or agents present in the employer's workplace, and it must be planned and delivered in consultation with the joint health and safety committee or worker representative. Training must be reviewed, up-dated and repeated every year—or more often if there are changes in materials used or processes or other work conditions or hazard information. The consultation process must be repeated in each case as well.



Training Content:

The content of worker training must meet the minimum requirements laid down by the WHMIS Regulations. Workers must be trained in:

i) the content of supplier labels and workplace labels;
ii) contents of the MSDS;
iii) procedures for safe handling, storage and disposal of the hazardous materials used or produced in that particular workplace;
iv) procedures for safe handling and disposal of a hazardous material contained or transferred in piping systems, processor reaction vessels, tank cars, trucks or conveyors;
v) procedures to be followed in case of fugitive emissions, (for example: escaping gas, fumes or vapour); and
vi) emergency procedures for all situations involving a hazardous material.

More details about worker training may be found in Module 2, Information Delivery.

THE RIGHT TO KNOW

WHMIS, or The Right To Know, is not just another government regulation. It deals with the preservation of life and health against hazardous substances which are sometimes involved in our jobs. The industry, labour and government representatives who got together to create WHMIS were working to save Canadians from injury or damage to health on the job.

They designed a system which gives vital information to each and every person in the workplace. Each worker can and should use this information for self-protection against the harmful effects of hazardous materials at work.

REVIEW QUESTIONNAIRE

This questionnaire will help you and your group to review selected information covered in your training.

1. To implement WHMIS, the following federal and provincial laws have been passed:

a. Bill C-70: An Act to amend the Hazardous Products Act

b. Controlled Products Regulation

c. The Hazardous Materials Information Review Act and Regulations

d. Bill 79: An Act to amend the Occupational Health and Safety Act

e. All of the above

f. None of the above

2. The purposes of Bill 79 are to:

a. Implement WHMIS in the workplace

b. Protect workers

c. Provide worker and community access to information

d. All of the above

e. None of the above

3. What two items not covered by WHMIS are addressed in Bill 79?

1. __________

2. __________

4. Complete the following partial list of WHMIS classes of hazardous materials:

1. Compressed Gas
2. Flammable and Combustible Materials
3. Corrosive Material
4. oxidizing material
5. poisonous & infectious material
6. dangerously reactive material

5. List at least three responsibilities that employers have under Bill 79, respecting:

a. Hazardous Materials

1. __________
2. __________
3. __________

b. Hazardous Physical Agents

1. __________
2. __________
3. __________

6. Under Bill 79, community access to information about hazardous materials involves the Medical Officer of Health.

a. True

b. False

7. What role do Joint Committees have under Bill 79?

____

____

____

8. Under Bill 79, a Ministry of Labour Inspector can order that a hazardous material not be used in a workplace if the MSDS for that material is not available.

a. True

b. False

9. The protection of legitimate trade secrets under WHMIS is:

a. Possible through the Hazardous Materials Information Review Commission

b. Impossible

c. Possible through the Ministry of Labour

d. Possible through the Ministry of Health

APPENDIX 'A'

GLOSSARY OF TERMS

CONTROLLED PRODUCT:
Any product, material or substance specified by the Controlled Products Regulations and adopted by provincial legislation as a hazardous material.

DESIGNATED SUBSTANCE:
A biological, chemical or physical agent prescribed as a designated substance under the Occupational Health & Safety Act, and to which the exposure of a worker is prohibited, regulated, restricted, limited or controlled.

EMPLOYER:
A person who:

a) employs one or more workers, or contracts for the services of one or more workers; and includes: A contractor or sub- contractor who:
   a) performs work or supplies services, or
   b) undertakes with an owner, constructor, contractor or subcontractor to perform work or supply services.

INDICTABLE OFFENCE:
(Also see SUMMARY CONVICTION OFFENCE): Generally, a more serious criminal charge as distinguished from a summary offence. A trial by judge and jury is the most common form of trial for serious indictable offences.

HEALTH & SAFETY REPRESENTATIVE:
A health & safety representative selected under the Occupational Health & Safety Act.

JOINT COMMITTEE:
A joint health and safety committee established under the Occupational Health & Safety Act.

LABEL:
Any mark, sign, device, stamp, seal, sticker, ticket, tag or wrapper, that contains prescribed information.

MATERIAL SAFETY DATA SHEET:
A document disclosing prescribed information. The data may be transmitted by any physical, electronic, optical or other means.

PRESCRIBED:
As prescribed by a regulation under the relevant Act.

SUMMARY (CONVICTION) OFFENCE:
Generally speaking, summary offences, which may be federal or provincial, are those of a less serious nature than indictable offences and carry a lesser penalty. Summary offences are tried by magistrates.

SUPPLIER:
A manufacturer, processor or packager of a controlled product or hazardous material who, in the course of business, imports or sells controlled products.

WORKER:
A person who performs work or supplies services for monetary compensation.

WORKPLACE:
Any land, premises, or location, upon or near which a worker works.

WHMIS
RIGHT TO KNOW
INFORMATION DELIVERY

Participant Guide

June, 1988

MODULE TWO B

TERMINAL OBJECTIVE:

The participants will know the different types of information available to them under the Right to Know and know the purpose of that information.

PERFORMANCE OBJECTIVES:

The participants shall:

1) Explain the contents of labelling.

2) Explain the contents of Material Safety Data Sheets.

3) Explain the requirements of worker training.

EVALUATION:

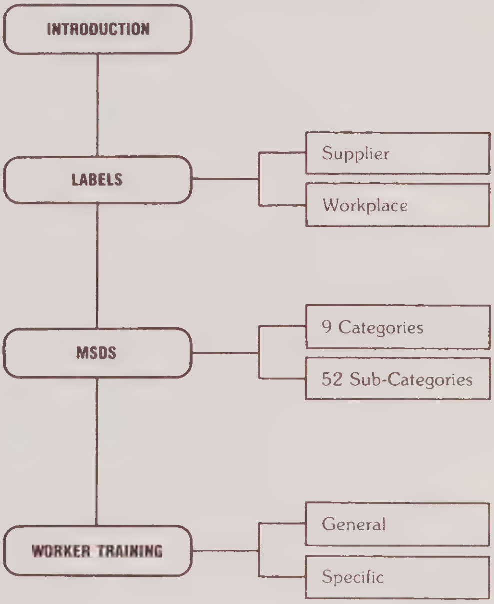
The participants, in groups, will:

1) List the contents required on a label.

2) List the contents required on a Material Safety Data Sheet (MSDS).

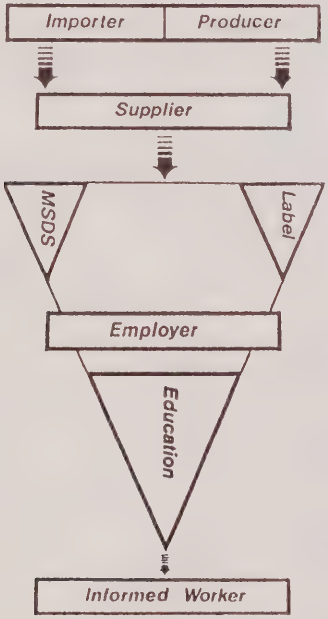
3) List the contents of a good worker training program.

FLOWCHART



INFORMATION DELIVERY

In the first module we have learned how the Workplace Hazardous Materials Information System (WHMIS) became law. We also learned something about the special responsibilities of suppliers and employers and about the kinds of information to be made available at the workplace. INFORMATION DELIVERY describes how the information is delivered to workers on the job.



There are three parts to the WHMIS information delivery system:

- labels,
- safety data sheets (called Material Safety Data Sheets or MSDS), and
- worker training (in how to use the labels and MSDS).

The label is the first information workers and employers will see on the job. It is attached to each container of hazardous material. The label gives a warning which is easy to see and read, about the kind of hazard presented by the material inside: whether it is explosive, flammable, corrosive, etc. Further information on the label, in language which can be understood deals with the precautions to be taken, and directs the way to the next element in the system (MSDS). The Material Safety Data Sheet is where more detailed information about the material is available.

Subject to specific exemptions (e.g. consumer products and bulk shipments), no one can import or sell a hazardous material for use in a Canadian workplace unless the container has a label applied to it, and no one can bring a hazardous material into a Canadian workplace unless it bears a label **and** unless an MSDS for that material is available to the workers.

WHMIS LABELS

There are two types of labels: a **supplier label** and a **workplace label.** In addition, there may be cases where other kinds of identifiers are used, where labels are not practical or not necessary for health and safety. Examples are: identifiers posted near piles of bulk material or on piping systems which carry hazardous materials.

Supplier Labels

Any container of hazardous material, which falls within the criteria of the Controlled Products Regulations and is not exempt, brought into a Canadian workplace must carry a supplier label. This section deals with the **contents** of supplier labels, and their **format** (appearance) and other requirements.

Supplier Label Contents

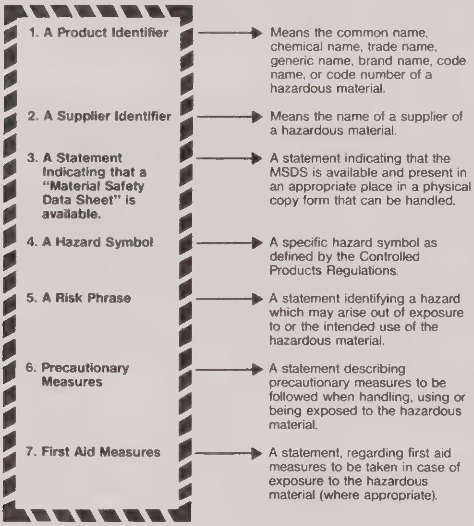
The contents of the label depends on the size of the container. **Small containers, less than 100 millilitres** in volume, must show the following information:

1) product identifier (name of the product);
2) supplier identifier (name and address of supplier);
3) a statement to let the reader know that a MSDS for this material is available;
4) a hazard symbol(s) to show tbe danger(s) associated with the material.

Since 100 millilitres is less than one-third the size of a beer can, there is only enough space for the most vital information. But, **containers larger than 100 millilitres** must display these four, plus three additional items of information as follows:

5) risk phrases (a short description of the hazard or hazards);
6) precautionary measures (how to handle it safely); and
7) first aid measures to be taken in case someone is harmfully exposed to the material,

COMPONENTS OF A SUPPLIER LABEL (VOLUME > 100 ml.)



Containers of over 100 mls.

1. Product Identifier:
The name of the product which may be its common name, chemical name, generic name, trade name, brand name, code name or code number.

The same name must appear on the MSDS for the product.

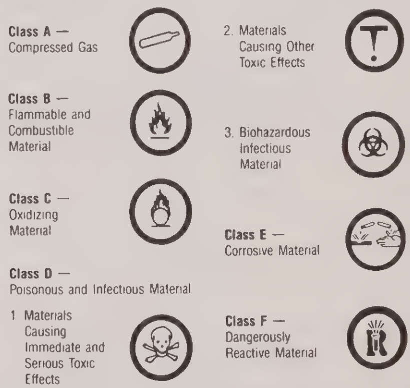
2. Supplier Identifier:
The name of the supplier. (A distributor who buys from a supplier and re-sells without repackaging need not be mentioned on the supplier label).

3. MSDS Statement:
A statement to the effect that a MSDS is available for the product. For example: "SEE MATERIAL SAFETY DATA SHEET"

4. Hazard Symbol:
One or more of the eight hazard symbols which apply to the product.

If a controlled product comes under both Divisions 1 and 2 of Class D, only the Division 1 symbol must be displayed on the label.

The symbols must be exact reproductions of the prescribed WHMIS symbols except for size and colour.



5. Risk Phrases:
These are descriptions of the effects which may result from exposure. They give further information about the hazard indicated by the symbol. For example: "dangerous if inhaled".

6. Precautionary Measures:
This section explains how to avoid the risks associated with the product. For example: "wear appropriate eye protection".

7. First Aid Measures:
This section explains how to treat a person who has been overexposed to the product. For example: "wash affected area under running water".

Supplier Label Exceptions

Lab Supplies: The information requirements for labels are not the same for hazardous materials in containers weighing less than 10 kilograms, from a laboratory supply house and used in a laboratory. In this case, the supplier's name and the hazard symbol [items 2) and 4) above] can be left off the label, but other five items must remain.

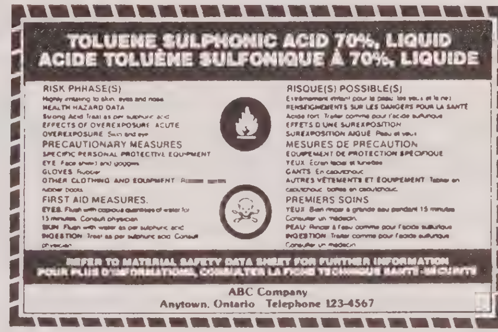
Trade Secrets: In certain cases, a supplier or employer may be allowed to withhold information from a label if it would reveal a trade secret. Where any information is missing for this reason, the label must carry a statement to that effect, together with the date of filing of the claim for trade secret protection and the claim registration number or the date the claim was allowed by the authorities.

In any case the product must be identified by its generic name (the chemical family it belongs to) and the correct WHMIS hazard symbols must appear.

If the employer (rather than the supplier) is the one claiming trade secret protection, the label must also show at least the supplier's code number for the product even if the supplier's name is not shown.

Supplier Label Format and other requirements

Colour, Size and Shape: The supplier label must be surrounded by the distinctive WHMIS border.



There is no specified rule for the size, shape or colour of the label, but it must contrast with the background colour of the container. Letters, numbers and borders may be in any colour as long as the label is distinctive from other markings. In other words, a yellow label is not allowed on a yellow drum, or a brown label on a brown bag, and so on.

Language: The data on supplier labels must be printed in English and French, either on a single, bilingual label or on two separate labels.

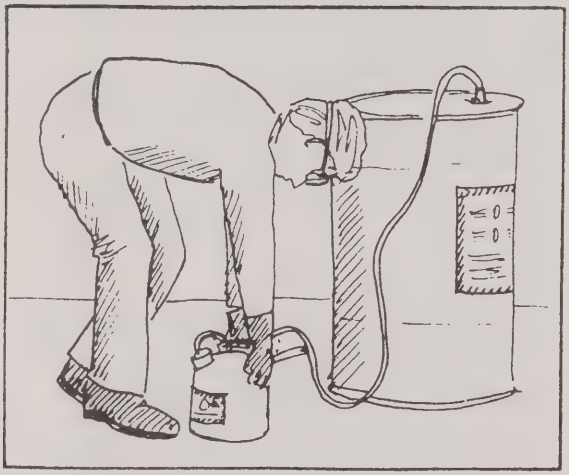
Durability and Application: The label must be made of strong enough material to remain attached and readable under normal conditions of transport, use and storage. It may be attached to the product or container, or it may be printed, stencilled or embossed on it. It should be positioned so that it will be easily seen under normal conditions.

Other Requirements: A supplier label must be attached to all containers of hazardous materials, **but** where the supplier ships them inside a larger container, and where the employer receiving the shipment has agreed in writing, the supplier can ship the labels and the employer will attach them to the individual containers, when the shipping crate is opened on arrival. If the shipment is in bulk, to be used or packaged after arrival, the employer receiving the shipment may advise the supplier, in writing, that he/she will supply workplace labels for the product when the shipment is received.

Workplace Labels

Workplace labels are used on hazardous materials or their containers, instead of supplier labels, in the following circumstances:

1) the material is produced in the workplace for use in the workplace or for export;
2) the material is produced in the workplace and intended for sale in Canada and will therefore have a supplier label attached before shipment;
3) the material is decanted from a supplier's labelled container into another container after its arrival in the workplace;



(Note: No WHMIS label needed where decanted material will be used immediately, or will be used up during the same shift by the person who decanted it, but the name of the material must be written on its new container.)

4) the original supplier label is missing or becomes unreadable.

None of these labelling rules applies to "fugitive emissions", which are small amounts of the material that are given off or escape from the process.

Workplace Label Contents

COMPONENTS OF A WORKPLACE LABEL

1. A Product Identifier	Means the common name, chemical name, trade name, generic name, brand name, code name, or code number of a controlled product.
2. Safe Handling Instruction	Information and instructions for the safe handling of a controlled product.
3. A Statement Indicating that a "Material Safety Data Sheet" is Available	A statement indicating that the MSDS is available and present in an appropriate place in a physical copy form that can be handled.

Three pieces of information are required on all workplace labels:

1) product identifier (name of the material);
2) precautionary measures (how to handle it safely); and
3) a statement telling the reader that a Material Safety Data Sheet is available for this material.

Revision: Workplace labels must be revised and updated when new information becomes available that necessitates a change in any of these contents. The revised label must not contradict the MSDS for that material.

Workplace Label Format and other requirements

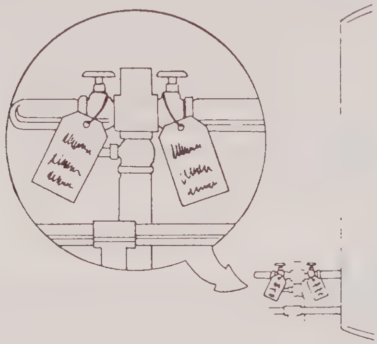
TOLUENE SULPHONIC ACID 70%, LIQUID

USE ONLY WITH FACE SHIELD, GOGGLES, RUBBER GLOVES, RUBBER APRON AND RUBBER BOOTS

REFER TO MATERIAL SAFETY DATA SHEET FOR FURTHER INFORMATION

There are no specific requirements on the colour, size or shape of the workplace label. It is important that it be distinctive and easily seen by workers, because it may be the first information they see about a hazardous material. The same general requirement applies to the workplace identifier which is used in place of the label in some circumstances.

Use of Workplace Identifiers (instead of labels)



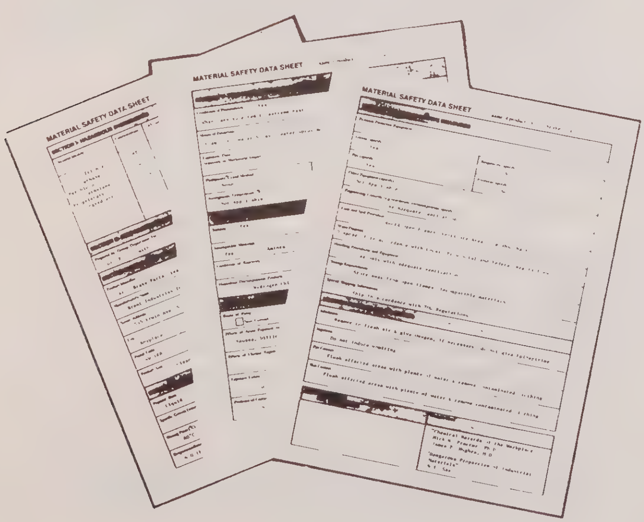
Often at the workplace, material flows through pipes, or is kept in process or reaction vessels, or in tanks or trucks, or carried on conveyors. In these cases, it must be identified means of colour coding (for example, painting the pipes which carry that material with a distinctive identifying colour), or by labels, placards, or other means which identify the material so that the worker is warned of its presence.

The circumstances where use of a workplace label may be impractical and where workplace identifiers can be substituted are as follows:

Circumstance	Workplace Identifier
Hazardous wastes produced in the workplace	Any type of idenfifier (label, placards, warning signs, etc.) to ensure workers recognize the waste material.
Product produced in a workplace and not in a container of any kind.	Posted placard containing same information as the workplace label but whose size and location make it conspicuous and clearly readable
Product contained in a transfer or reaction system such as pipes, process vessel, tank car or truck, or conveyor.	Colour coding, labels, placards or other means of identifying contents to ensure worker saftey
Product transferred to a new container which is a) to be used only in a laboratory or, b) which is portable, filled directly from a labelled container, and is either required for immediate use, or is under the control of the employee who filled it and who will use it up completely during that shift.	Clearly identified contents (e.g. by writing names, number codes, or letters on containers, or nearby).
Mixtures and substances undergoing analysis, testing or evaluation in a laboratory.	Clearly identified contents (e.g. by writing names, number codes, or letters on containers, or nearby).

MATERIAL SAFETY DATA SHEETS (MSDS)

The Data Sheet or MSDS is the backup to the label. The label alerts a worker with a brief profile of a hazardous material. The MSDS contains detailed information about the product.



The MSDS contains important added data on:

a) health risks of exposure;
b) the safest method of using or storing the material;
c) protective measures for workers who may be exposed;
d) emergency procedures.

The format or design or order of the MSDS is not laid down in the law, but it must provide nine separate categories of information. The nine categories are listed and explained on the next page.

MSDS Contents

Nine categories of information are required on a MSDS whether developed by the supplier, or the employer for workplace produced products. The categories are as follows:

1. hazardous ingredients,
2. preparation information,
3. product information,
4. physical data,
5. fire or explosion hazard,
6. reactivity data,
7. toxicological properties,
8. preventive measures,
9. first aid measures.

In addition to these categories, the supplier or employer must include any other hazard information of which he ought reasonably to be aware.

Much of the information provided in the MSDS is of a technical nature, and is addressed primarily to engineers, occupational hygienists, fire fighters, emergency co-ordinators and others who may be directly involved in the planning of controls and procedures for the use, storage or disposal of the material or for the treatment of emergencies involving the material. It is useful for all employees in the workplace to have an understanding of this information to protect their own health and safety.

NOTE:
The INFORMATION RESOURCES section in Appendix A lists publications which may provide a better understanding of the terms encountered in the MSDS.

Because the MSDS is an important starting point for developing a control program, it is important to understand the significance of the information contained in each category or section.

SECTION I- HAZARDOUS INGREDIENTS					
Chemical Identity	Concentration	CAS Number	PIN Number	LD_{50} Species and Route	LC_{50} Species and Route

1. Hazardous Ingredients

Lists all ingredients of the product which come under any of the eight hazard classes. The concentration of each ingredient is also listed. Concentration means the weight of the ingredient as a percentage of the weight of the product.

Gives the Chemical Abstracts Service (CAS) number for each hazardous ingredient. This makes it easier to track down additional information on a particular chemical.

SECTION II- PREPARATION INFORMATION		
Prepared by (Group, Department, Etc.)	Phone Number	Date of Preparation

2. Preparation Information

Gives the name and phone number of the person or department who prepared the Data Sheet, as well as the date on which it was prepared.

If the date shown is more than three years before the date of sale, the Data Sheet is considered expired and must be replaced. the employer may get an updated MSDS from the supplier or, if that is no possible, the employer must update the Data Sheet by adding any new hazard information on any of the listed ingredients.

For materials produced in the workplace, the MSDS must be revised every three years or within 90 days of new hazard information.

SECTION III- PRODUCT INFORMATION			
Product Identifier			
Manufacturer's Name		Supplier's Name	
Street Address		Street Address	
City	Province	City	Province
Postal Code	Emergency Tel. No.	Postal Code	Emergency Tel. No.
Product Use			

3. Product Information

Names the product by the same name used on the label. Explains what the product is used for. Gives the product's chemical name, the name of the chemical family it belongs to, the chemical formula, the molecular weight and lists any other names by which the product is known.

Names the product's manufacturer or supplier. Gives the addresses of both and telephone numbers to use in case of an emergency.

SECTION IV- PHYSICAL DATA			
Physical State	Odour and Appearance		Odour Threshold
Specific Gravity	Co-efficient of Water/Oil Distribution		Vapour Pressure
Boiling Point (C)	Freezing Point (C)	pH	Vapour Density (Air=1)
Evaporation Rate (BuAe=1)		Per cent Volatile (by volume)	

4. Physical Data

Explains how the material behaves when in use. This section is broken down into twelve different pieces of information. The breakdown categories include such descriptions as physical state, odour and appearance, specific gravity, freezing and boiling point, vapour density, vapour pressure and evaporation rate.

Some parts of this information are more highly technical than others.

Overall, they tell us:

- whether the material is a gas, a solid or a liquid,
- what it looks and smells like when in use;
- how likely it is to evaporate (materials which evaporate easily are usually more dangerous);
- whether its gases rise or sink (important for air monitoring and ventilation);
- how it can enter the body and what effects it may have.

SECTION V- FIRE EXPLOSION HAZARD		
Conditions of Flammability		
Means of Extinction		
Explosion Data Sensitivity to Mechanical Impact	Sensitivity to Static Discharge	
Flashpoint (°C) and Method	Upper Flammable Limit %	Lower Flammable Limit %
Autoignition Temperature (°C)	Hazardous Combustion Products	

5. Fire or Explosion Hazard

Describes the likelihood of the material burning or exploding under different circumstances such as: exposure to various temperatures, effects of static electricity, sharp impacts, and so on.

The information shown here helps in the safe design of the processes which use the material, the proper ventilation and work practices to use in handling it and the kinds of emergency equipment such as fire extinguishers, etc., which will be the most effective.

SECTION VI- REACTIVITY DATA
Stability
Incompatable Materials
Conditions of Reactivity
Hazardous Decomposition Products

6. Reactivity Data

Describes the stability of the material: how it behaves when exposed to certain other chemicals, or to heat, light, vibration, air or moisture, etc.

Obviously, a material should be used and stored away from substances or physical agents (light, heat, etc.) which can cause it to react in a hazardous way.

SECTION VII- TOXICOLOGICAL PROPERTIES				
Route of Entry				
Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
Effects of Acute Exposure to Product				
Effects of Chronic Exposure to Product				
Exposure Limits	Irritancy to Product		Synergistic Products	
Evidence of Carcinogenicity, Reproductive Toxicity, Teratogenicity or Mutagenicity?			Sensitivity to Product	

7. Toxicological Properties

Explains how the material can affect the worker's health; how it enters the body, by inhalation, absorption or ingestion as will as the conditions or diseases it may cause.

Describes the acute effects (immediate symptoms) and chronic effects (continuing symptoms) which may result from human exposure to the material.

SECTION VIII- PREVENTATIVE MEASURES	
Personal Protective Equipment	
Gloves (specify)	Respiratory (specify)
Eye (specify)	Footwear (specify)
Other Equipment (specify)	
Engineering Controls (e.g. ventilation, enclosed process, specify)	
Leak and Spill Procedure	
Waste Disposal	
Handling Procedures and Equipment	
Storage Requirements	
Special Shipping Information	

8. Preventive Measures

Recommends safe procedures for handling, use and storage of the material, based on all the hazard information given in other sections of the MSDS.

SECTION IX- FIRST AID MEASURES
Inhalation
Ingestion
Eye Contact
Skin Contact

9. First Aid Measures

Describes the immediate treatment to be given to a person who has been affected by exposure to the material.

Treatment steps are usually described in chronological order: what to do first, second, third, etc., starting with the removal of the victim from the unsafe area.

Additional Information	Sources Used

Additional Information

This space may contain any relevant information the manufacturer may feel would be useful to the user. Additional toxicological or other scientific information may be included.

Location of the MSDS

A Material Safety Data Sheet for each hazardous material present in the workplace must be available at the worksite to be read by any worker who may be exposed to a hazardous material. Usually, the information on a single hazardous material takes up more than one sheet of paper. Some workplaces may keep the sheets in a looseleaf binder. Others may store them in a special file. There is no set rule for the form they must take. The MSDS must also be available to members of the Joint Health and Safety Committee or worker Health and Safety Representative.

An MSDS may also be made available in electronic form on a computer terminal, provided the terminal is maintained in working order and workers are trained to use it. However, paper copies of the MSDS must be made available for anyone who requests it in that form.

The Generic MSDS

Where a group of different hazardous materials have a similar chemical composition, a single **generic** MSDS may be used to apply to all of them. But if the hazard information for any of the products in the group is different than the others, that information must also be reported on the generic MSDS.

Language of the MSDS

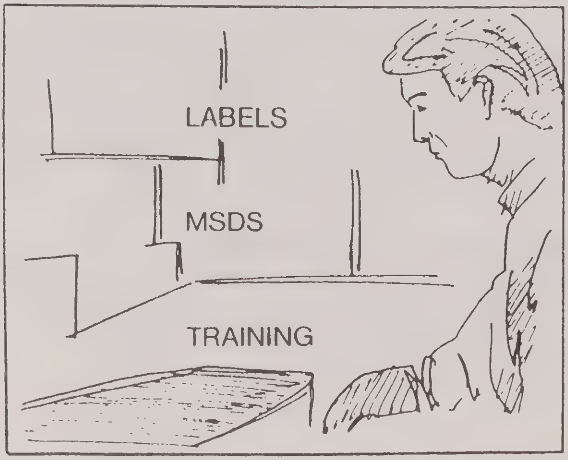
Each MSDS must be available in English and in any other language prescribed by regulations.

WORKER EDUCATION PROGRAMS

Worker Education Programs are intended to show workers how to use the WHMIS labels, MSDS and other information, to work with hazardous materials in a healthy and safe manner. It is the employer's responsibility to educate any employee who works with or near a hazardous material.

General and Specific Education

A worker education program contains two types of education: **general** education (which some people like to call "generic") and **specific** education. **General** education concerns the purpose of WHMIS and how to understand and use supplier and workplace labels, workplace identifiers and Material Safety Data Sheets (MSDS). **Specific** education is concerned with the actual hazardous materials present in the workplace whose workers are taking the education program, and with the work routines and emergency procedures used in that workplace.



Contents of General Education (Generic)

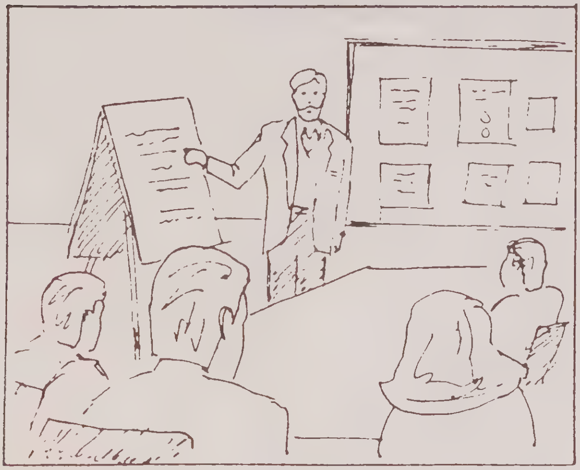
The most important elements of the general education part of the program are:

1) information on supplier and workplace labels and what it means;
2) information on the MSDS and what it means:
3) how chemicals enter the body and what effects they have on the body;
4) principles for the control of hazardous materials, and procedures for their safe use, handling and storage;
5) special procedures for use, and handling of hazardous materials in pipes, process vessels, tanks, conveyor systems, etc. and so on;
6) how to deal with fugitive emissions (e.g. escaping fumes, vapours, etc.
7) what to do in emergencies where hazardous materials are involved.

Contents of Specific Education

Specific education covers almost the same ground as general, but deals with the actual situations met by workers on the job. The contents of specific education are decided after a workplace assessment has been done to find answers to the following questions:

1) What hazardous materials are present in the workplace, and where are they used and stored?
2) What levels of exposure to each hazardous material are being experienced by workers?
3) What kinds of controls are being used to isolate the materials from workers or workers from the material and how effective are they?
4) What are the existing procedures for disposal of hazardous wastes?
5) What are the details of emergency plans for dealing with spills, leaks, fires, explosions?
6) Where and when is personal protective equipment used; how are workers trained in its use and maintenance, and what are its limitations?



The **specific** part of the worker education program ensures that the **general** education can be properly applied at the **particular workplace** and on the **particular job** to deal with **particular hazardous materials**. It may also reveal weak areas where improvements are needed in existing controls and work procedures.

Planning, Delivery and Review of the Worker Education Program

Planning and Delivery

Every worker education program must be **workplace specific**. In other words, it must answer the questions outlined above in the section on Contents of Specific Education.

Each worker education program must also be **performance based**. This means that the worker must be able to apply the information from the program to protect his/her own health and safety. It is the employer's responsibility to make sure that the worker education program actually produces these practical results.

To ensure that the worker education program meets all the necessary requirements, it must be developed and carried out in **consultation** between the **employer** and the **Joint Health and Safety Committee or worker Health and Safety Representative** at the workplace.

Review

The worker education program must be reviewed **at least once a year**. Review means finding out if the workers are thoroughly familiar with the education and on the job training received. It also means repeating the program, to update the knowledge of the workers who attended the education session a year prior, and to educate any new workers.

There may have been **changes** in the process or other procedures involving hazardous materials, or **new information** may have been discovered about a hazardous material, or **improved control or emergency equipment** might have become available. In any of these cases, the worker education program must be changed to incorporate these new facts.

As in planning and implementing the program, the **employer consults** with the **Joint Health and Safety Committee** or the worker **Health and Safety Representative** at the workplace when reviewing the program. The Committee (or Representative) may also advise the employer if it sees a need for more frequent reviews of the education.

CONCLUSION

The concept behind the Workplace Hazardous Materials Information System (WHMIS) is **the worker's right to know** about hazardous materials present in the workplace.

This is another example of where we see that **information is a tool** which can be used by the employer and the workers, to protect their **health and safety on the job**. WHMIS ensures that this information goes from the **producer or supplier** of a hazardous material to the employer and from the **employer** to the worker. This transfer of information involves three mechanisms: the WHMIS label; the Material Safety Data Sheet and the Worker Education Program.

WORKSHEETS & REVIEW QUESTIONNAIRE

1. Labels Activity Sheets

2. MSDS Activity

3. Review Questionnaire

Labels

ACTIVITY SHEETS

Working in table groups, examine the sample labels reproduced on the following two pages. Select those that are WHMIS labels and in the space provided, describe the type of WHMIS label that each selected label is (e.g. workplace label, supplier label > 100 ml., etc.)

ETHANOL

- Flammable liquid
- Vapour harmful

- Keep away from sources of ignition.
- In case of fire, use alcohol resistant foam.
- Use in an adequately ventilated area.

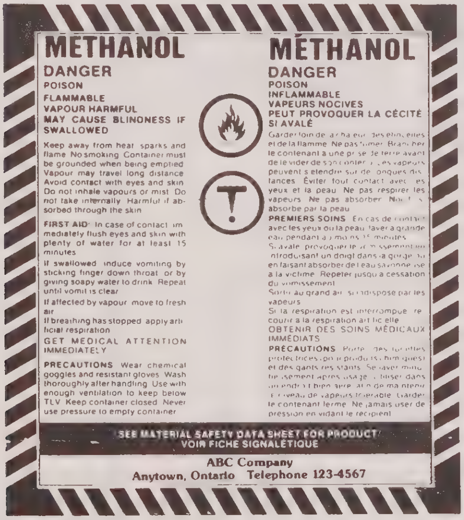
If inhaled: Remove victim to fresh air and perform artificial respiration if necessary.

If swallowed: If victim is conscious, induce vomiting. Call physician immediately.

If splashed on skin or eyes: Flush the skin or eyes with plenty of water and remove contaminated clothing. Call physician immediately.

Refer to the Material Safety Data Sheet for more information

____________________________ LABEL



METHANOL

DANGER

POISON

FLAMMABLE

VAPOUR HARMFUL

MAY CAUSE BLINDNESS IF SWALLOWED

Keep away from heat sparks and flame No smoking Container must be grounded when being emptied Vapour may travel long distance Avoid contact with eyes and skin Do not inhale vapours or mist Do not take internally Harmful if absorbed through the skin

FIRST AID: In case of contact immediately flush eyes and skin with plenty of water for at least 15 minutes

If swallowed induce vomiting by sticking finger down throat or by giving soapy water to drink Repeat until vomit is clear

If affected by vapour move to fresh air

If breathing has stopped apply artificial respiration

GET MEDICAL ATTENTION IMMEDIATELY

PRECAUTIONS Wear chemical goggles and resistant gloves Wash thoroughly after handling Use with enough ventilation to keep below TLV Keep container closed Never use pressure to empty container

MÉTHANOL

DANGER

POISON

INFLAMMABLE

VAPEURS NOCIVES

PEUT PROVOQUER LA CÉCITÉ SI AVALÉ

Garder loin de [illegible] des étincelles et de la flamme Ne pas fumer Brancher le contenant à une prise de terre avant de le vider de son contenu Les vapeurs peuvent s'étendre sur de longues distances Éviter tout contact avec les yeux et la peau Ne pas respirer les vapeurs Ne pas absorber [illegible] absorbé par la peau

PREMIERS SOINS En cas de contact avec les yeux ou la peau laver à grande eau pendant au moins 15 minutes

Si avalé provoquer le vomissement en introduisant un doigt dans la gorge ou en faisant absorber de l'eau savonneuse à la victime Répéter jusqu'à cessation du vomissement

Sortir au grand air si indisposé par les vapeurs

Si la respiration est interrompue recourir à la respiration artificielle

OBTENIR DES SOINS MÉDICAUX IMMÉDIATS

PRÉCAUTIONS Porter des lunettes protectrices pour produits chimiques et des gants résistants Se laver minutieusement après usage Utiliser dans un endroit bien aéré afin de maintenir le niveau de vapeurs tolérable Garder le contenant fermé Ne jamais user de pression en vidant le récipient

SEE MATERIAL SAFETY DATA SHEET FOR PRODUCT/
VOIR FICHE SIGNALÉTIQUE

ABC Company
Anytown, Ontario Telephone 123-4567

____________________________ LABEL

METHANOL

- Flammable liquid
- Vapour harmful
- May cause blindness

Risk phrases and precautionary phrases in French

- Keep away from sources of ignition
- In case of fire, use alcohol foam
- Avoid prolonged or repeated breathing of vapour and contact with skin

IF INHALED: Move victim to fresh air. If breathing has stopped, give artificial respiration or oxygen.

IF SWALLOWED: If the victim is conscious, give him a glass of warm water containing one tablespoon of salt in order to induce vomiting. Keep victim warm and cover eyes to exclude light. Contact a physician immediately.

IF SPLASHED ON SKIN OR EYES: Flush affected area with water.

SEE MATERIAL SAFETY DATA SHEET

NAME AND ADDRESS OF SUPPLIER:

____________________ LABEL

METHANOL

FLAMMABLE - DO NOT USE NEAR AN OPEN FLAME OR PROCESSES THAT GENERATE SPARKS.

AVOID INHALING VAPOURS.

READ THE MATERIAL SAFETY DATA SHEET BEFORE USING THIS COMPOUND.

____________________ LABEL

May cause blindness if swallowed. Avoid contact with the eyes. Cannot be made non-poisonous. Use only in well ventilated areas. Keep away from heat and open flame.

4 litres

DANGER

FIRST AID TREATMENT: Contains methyl alcohol. In case of contact with eyes, wash thoroughly. If swallowed, induce vomiting by placing fingers or spoon at back of throat. Call physician immediately. Keep patient warm.

____________________ LABEL

CKL ACRYLIC ENAMEL REDUCER

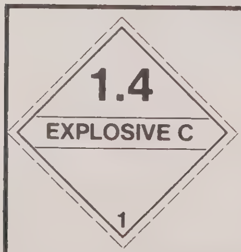
CONTAINS:

TOLUENE	85% w/w
XYLENE	15% w/w
N-BUTYL ACETATE	5% w/w

HAZARDOUS LABORATORY SAMPLE. FOR HAZARD INFORMATION CALL 999-9999

CKL INDUSTRIES
99 ROOK STREET
ANYPLACE, ON
B2W 4E5

____________________ LABEL



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____________________ LABEL

MATERIAL SAFETY DATA SHEETS

Group Activity

Working in table groups, examine the MSDS provided in the following pages.

Going through it, section by section, identify those areas of concern about which you feel you would need further clarification from the supplier.

MATERIAL SAFETY DATA SHEET

name of product: KL-Z Brake Parts Cleaner

SECTION I- HAZARDOUS INGREDIENTS

Chemical Identity	Concentration	CAS Number	PIN Number	LD50	LC50-
1,1,1 Trichloro-ethane	48%	00071-55-6		Not Available	Not Available
Perchloro-ethylene	42%	00127-18-4		Not Available	Not Available
Proprietary Ingredient	5-10%	00124-38-9		Not Available	Not Available

SECTION II- PREPARATION INFORMATION

Prepared by (Group, Department, Etc.)	Phone Number	Date of Preparation
Dr. P. L. Smith	497-777	5 Feb. 1982

SECTION III- PRODUCT INFORMATION

Product Identifier: KL-Z Brake Parts Cleaner

Manufacturer's Name		Supplier's Name	
Brent Industries Inc.		Fritz Chemical Supply House	
Street Address: 555 Erwin Ave. S.		Street Address: 333 Davis Drive	
City: Anyplace	Province: Ont.	City: Otherplace	Province: Ont.
Postal Code: Z4W 1K8	Emergency Tel. No.: 777-5432	Postal Code: P9K 5Z4	Emergency Tel. No.: 444-5555

Product Use: Cleaning Brake Parts

SECTION IV- PHYSICAL DATA

Physical State	Odour and Appearance		Odour Threshold
Liquid	Clear, Colourless Liquid; Chlorinated Solvent Odour		
Specific Gravity (water = 1)	Co-efficient of Water/Oil Distribution		Vapour Pressure: 127
Boiling Point (°C): 80°C	Freezing Point (°C)	pH	Vapour Density (Air = 1): 4.89
Evaporation Rate (BuAc = 1): 6.0 (Ethyl Acetate = 1)		Per cent Volatile (by volume)	

MATERIAL SAFETY DATA SHEET

name of product: KL-Z Brake Parts Cleaner

SECTION V- FIRE EXPLOSION HAZARD

Conditions of Flammability Yes

When cans sujected to extreme heat

Means of Extinction

Foam, CO2, Water Spray. Water spray may be used to keep containers cool.

Explosion Data

Sensitivity to Mechanical Impact

Sensitivity to Static Discharge

Flashpoint (°C) and Method	Upper Flammable Limit %	Lower Flammable Limit %
None	Not Applicable	Not Applicable

Autoignition Temperature (°C)	Hazardous Combustion Products
Not Applicable	

SECTION VI- REACTIVITY DATA

Stability Yes

Incompatible Materials

Yes Amines

Conditions of Reactivity

Hazardous Decomposition Products

Hydrogen Chloride, Phosgene

SECTION VII- TOXICOLOGICAL PROPERTIES

Route of Entry

- [ ] Skin Contact
- [ ] Skin Absorption
- [ ] Eye Contact
- [X] Inhalation
- [X] Ingestion

Effects of Acute Exposure to Product

Nausea, Difficulty in Breathing

Effects of Chronic Exposure to Product

Exposure Limits	Irritancy to Product	Synergistic Products
50	Skin and Eye Irritant	Other Chlorinated Compounds

Evidence of Carcinogenicity, Reproductive Toxicity, Teratogenicity or Mutagenicity?	Sensitivity to Product
None	

MATERIAL SAFETY DATA SHEET

name of product: KL-Z Brake Parts Cleaner

SECTION VIII- PREVENTATIVE MEASURES

Personal Protective Equipment

Gloves (specify)	Respiratory (specify)
Yes	No
Eye (specify)	**Footwear (specify)**
Yes	No

Other Equipment (specify)
Not Applicable

Engineering Controls (e.g. ventilation, enclosed process, specify)
Use Adequate Ventilation

Leak and Spill Procedure
Avoid Open Flames; Ventilate Area, Use absorbent

Waste Disposal
Dispose of in accordance with Local, Provincial and Federal Regulations

Handling Procedures and Equipment
Use only with adequate ventilation

Storage Requirements
Store away from open flames, incompatible materials

Special Shipping Information
Ship in accordance with TOG Regulations

SECTION IX- FIRST AID MEASURES

Inhalation
Remove to fresh air & give Oxygen, if necessary; do not give Epinephrine

Ingestion
Do not induce vomiting.

Eye Contact
Flush affected areas with plenty of water & remove contaminated clothing

Skin Contact
Flush affected areas with plenty of water & remove contaminated clothing

Additional Information	Sources Used
Not applicable	"Chemical Hazards of the Workplace" Mick H. Proctor, Ph.D James P. Hughes, M.D. "Dangerous Properties of Industrial Materials" N.I. Sax

REVIEW QUESTIONNAIRE

PLEASE TAKE A MINUTE AND FILL OUT THE ANSWERS TO EACH OF THESE QUESTIONS. THE ANSWERS WILL BE TAKEN UP INDIVIDUALLY IN THE CLASS.

PART 1: LABELS

1. **The purpose of a WHMIS label is to:**
   a. Warn people
   b. Identify the hazardous material to be used
   c. Draw attention to the MSDS
   d. All of the above
   e. None of the above

2. **Under WHMIS legislation, two types of labels are presented. What are these?**
   1. ______________________________
   2. ______________________________

3. **Workplace labels must be put in place:**
   a. For employer produced products
   b. For decanted products
   c. If the supplier's label has been accidently removed or defaced
   d. All of the above
   e. None of the above

4. **What are the main differences between the supplier's label and the workplace label?**
   - ______________________________
   ____
   - ______________________________
   ____
   - ______________________________
   ____
   - ______________________________
   ____

PART 2: MSDS

5. **The purpose of an MSDS is to:**
   a. Give more information than found on a label
   b. Identify hazardous ingredients
   c. Give information on protective measures and emergency procedures
   d. All of the above
   e. None of the above

6. **Complete the following partial list of employer's duties with respect to an MSDS.**
   1. Produce MSDS for employer produced products
   2. Make MSDSs available in the workplace
   3. ______________________________
   4. ______________________________

7. **Complete the following partial list of information categories to be contained in an MSDS:**
   1. Hazardous Ingredients
   2. Preparation Information
   3. Product Information
   4. Physical Data
   5. Fire or Explosion Hazard
   6. ______________________________
   7. ______________________________
   8. ______________________________
   9. ______________________________

PART 3: WORKER EDUCATION PROGRAM

8. **The purpose of the Worker Education Program is to:**
   a. Provide hazard information
   b. Provide information on controls
   c. Both of the above
   d. None of the above

9. **Under the ammended Occupational Health and Safety Act, the joint committee must be consulted on:**
   a. The development of Worker Education Program
   b. The review of training and instruction
   c. The worker's familiarity with training and instruction
   d. All of the above
   e. None of the above

10. **According to regulations made under the Occupational Health and Safety Act, workers must receive instruction in:**
   a. Content and significance of information on labels and MSDSs
   b. Hazard information
   c. Procedures for safe use, handling, transfer, storage and disposal of hazardous materials
   d. Emergency procedures
   e. All of the above

11. **Because the Worker Education Program must be workplace specific and performance based, it is necessary to assess the workplace to determine training needs.**
   a. True
   b. False

APPENDIX 'A'

GLOSSARY OF TERMS

complex mixture:
A complex mixture is a substance that occurs in nature, and is not manmade. It includes products separated from a complex mixture by distillation or other separation process, and products created from a complex mixture by modification of one or more of the ingredients. Natural petroleum is a complex mixture as are its derivatives such as turpentine and petroleum distillates.

container:
Includes a bag, barrel, bottle, box, can, cylinder, drum or similar package or receptacle, but does not include a storage tank.

controlled product:
Any product, material or substance included in any of the six classes listed in Schedule II, of HPA.

designated substance:
A biological, chemical or physical agent prescribed as a designated substance under the Occupational Health & Safety Act, and to which the exposure of a worker is prohibited, regulated, restricted, limited or controlled.

employer:
For purposes of WHMIS, an employer is a person in charge of a workplace in which a hazardous material is present. An employer (whose business is the manufacture or repackaging of a controlled product for sale) is also a supplier.

fugitive emission:
A gas, solid, liquid, vapour, fume, mist, fog or dust that escapes from process equipment, from emission control equipment or from a product.

hazardous information:
Information on the proper and safe storage, handling and use of a controlled product, including information relating to its toxicological properties.

hazardous material:
A "controlled product" specified in HPA.

hazardous waste:
A controlled product intended for disposal or sold for recycling or recovery.

Ingredient Disclosure List:
A list compiled under subsection 17(1) of the *Hazardous Products Act.* It is a list of chemical ingredients, each with a corresponding concentration by per cent figure.

joint committee:
A joint health and safety committee established under the *Occupational Health and Safety Act.*

label:
Any mark, sign, device, stamp, seal, sticker, ticket, tag or wrapper.

laboratory sample:
A sample of a controlled product intended solely for testing in a laboratory . It does not include a controlled product that is to be used for testing other products, materials or substances, or for educational or demonstration purposes.

LD_{50} of Material:
LD = Lethal dose: the dose of the material which causes the death of 50% (one-half) of a group of test animals when given as a single dose. The LD_{50} can be measured for any route of exposure but the dermal (skin application) and the oral values are most relevant to the workplace.

LC_{50} of Material:
LC = Lethal concentration: the concentration of a material in air which causes the death of 50% of a group of test animals when given over a set period of time, usually 1 to 4 hours. The LC_{50} applies to materials that can be inhaled.

manufactured article:
An article formed to a specific shape or design during manufacture, the intended use of which, when in that form, is dependent in whole or in part on its shape or design, and that, under normal conditions of use, will not release a controlled product or cause a person's exposure to a controlled product.

Material Safety Data Sheet:
A document disclosing prescribed information. The data may be transmitted by any physical, electronic, optical or other means.

prescribed:
Means prescribed by a regulation under the relevant Act.

supplier (HPA):
A person who sells controlled products. A supplier may be the manufacturer of the product or the importer of the product from another country, or a person who purchases materials from a manufacturer or other supplier and repackages them for sale. Most suppliers are also "employers" in their applicable provincial labour jurisdictions.

INFORMATION RESOURCES

Federal Legislation

1. Hazardous Products Act (amended June 30, 1987)

2. Controlled Products Regulations

Provincial Legislation

1. Occupational Health & Safety Act of Ontario

2. An Act to Amend the Occupational Health & Safety Act (Bill 79)

3. Regulation Respecting the Distribution and Use of Information on Hazardous Materials Used in the Workplace.

Other Useful Resources

1. Workplace Hazardous Materials Information System: Report of the Project Steering Committee (for precautionary statements on labels) (Published by: Labour Canada).

2. A User's Guide to MSDSs (published by Industrial Accident Prevention Association).

3. Chemical Hazard Identification Guide (published by Industrial Accident Prevention Association).

4. Canadian Centre for Occupational Health and Safety, Hamilton (Enquiries: (416) 572-2981 or toll free 1-800-263-8276) (for assistance in classifying material, preparing and updating MSDSs).

5. The Material Safety Data Sheet — A Basic Guide for Users (published by Canadian Centre for Occupational Health and Occupational Safety).

6. The Material Safety Data Sheet — An Explanation of Common Terms (published by Canadian Centre for Occupational Health and Occupational Safety).

7. Training Aids (available from the Safety Associations).

Label and Identification as required by WHMIS

INFORMATION ON LABEL	SUPPLIER LABELS		LABORATORY LABELS		WORKPLACE LABELS	
	Labelling on a "Container"		Labelling of Laboratory supply	Labelling of Laboratory Samples	Labelling of decanted products	Labelling of produced products
	< 100ml	> 100ml	< 10 kg.	< 10 kg.		
Product Identifier	X	X	X	X	X	X
Supplier Identifier	X	X		X		
M.S.D.S. Statement	X	X	X		X	X
Hazard Symbol(s)	X	X				
Risk Phrase(s)		X	X			
Precautionary Measures		X	X			
First Aid Measures		X	X			
Safe Handling Info.					X	X
Chemical/generic ID				X		
Hazard statement *				X		
Supplier Emergency FH #				X		

* "Hazardous Laboratory Sample. For hazard information or in an emergency, call (emergency number)"

WHMIS

RIGHT TO KNOW

OCCUPATIONAL HEALTH

Participant Guide

June, 1988

MODULE THREE B

TERMINAL OBJECTIVE:

The participants will have an understanding of how the body is affected by hazardous materials.

PERFORMANCE OBJECTIVES:

The participant shall:

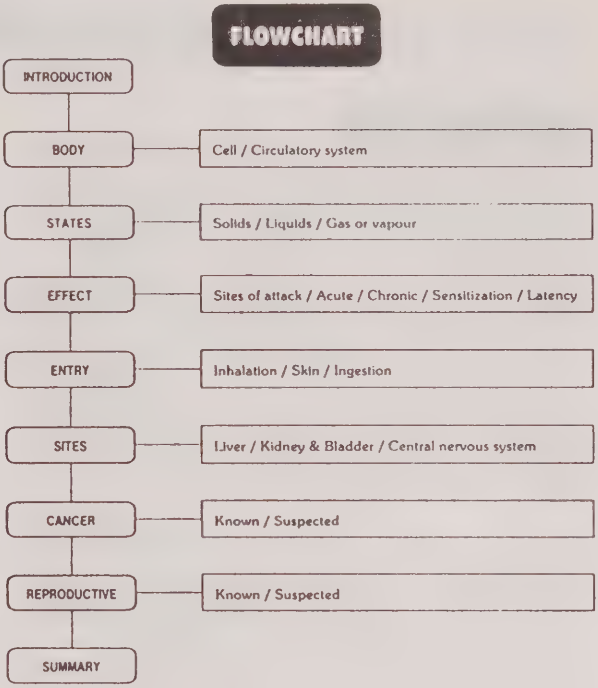
1) describe the cell and circulatory system;
2) explain the states a hazardous substance might take;
3) explain how hazardous substances affect the body;
4) explain the routes of entry for hazardous substances;
5) explain the routes of exit for hazardous substances;
6) explain how some hazardous substances may cause cancer;
7) explain how some hazardous substances may cause reproductive problems.

EVALUATION:

Given a basic understanding of how the body functions and the impact that hazardous substances have on it, the participant shall, in small groups, answer a series of questions on:

a) routes of entry and exit,
b) latency,
c) acute and chronic, and
d) the sites of the body affected by hazardous substances.

Their answers to be presented to the whole class and recorded on a flipchart.



BASIC OCCUPATIONAL HEALTH

INTRODUCTION

Canadians expect to enjoy a good life, free from injury and disease. Occupational hazards are unwanted and unintended by-products of work. All concerned parties — employers, employees and governments, are making efforts to reduce workplace health and safety hazards and improve the quality of working life. Occupational injuries, diseases and deaths are not "acceptable risks" to any of them. It is hardly surprising that Occupational Health and Safety is receiving so much attention.

Occupational health is a very broad subject. This module on Basic Occupational Health is designed only to provide workers with the basic knowledge to protect themselves against workplace hazards.

The information provided in Module l and 2 would be incomplete without basic knowledge about

- how the body functions;
- how various physical and chemical agents enter and leave the body by various routes;
- how these materials interfere with the body's normal functions and cause disease;
- how the body's defence system works, and the immediate and long-term effects of workplace exposures.

To explain these subjects fully in a brief module is an impossible task. Therefore, this module aims to provide important basic knowledge which will help workers to protect themselves on the job.

A list of references is provided at the end of the module for those interested in further reading.

This module is divided into 6 parts:

A) the cell

B) routes of entry and disease sites

C) the circulatory system

D) routes of exit and disease sites

E) the reproductive system and

F) latency and acute and chronic effects of workplace exposures

A. THE CELL

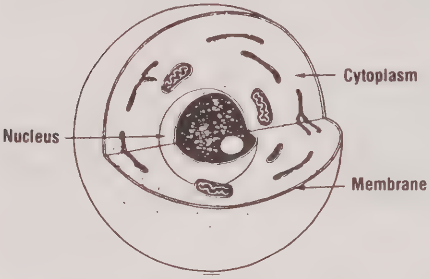
The human body is a large complex of parts and systems. Like an automobile, it has its pump, and its filters, etc. To understand how the harmful substances affect it, we will have a quick overview of some of the body's major organs and their functions.

The cell is the building block of all life. It is a tiny structure, usually no larger than 0.025 millimetres (0.001 inch) in diameter and thus too small to be seen with the naked eye. Simple forms of life, like amoebae or bacteria, consist of a single cell, but the human body is made up of trillions of them, each one specialized to perform a particular function. For example, red blood cells transport oxygen; white blood cells produce antibodies to help defend the body against infection; nerve cells generate and transmit electrical impulses to control our thoughts and movements; liver cells contain enzymes that can detoxify or remove the poison from certain harmful substances. Each organ and tissue of the body is comprised of billions of cells of a similar type. Cells are living structures and reproduce by dividing. Therefore, each human cell must be able to take in nutrients and convert them to more usable forms.

Cell Structure

Although cells are specialized to perform a variety of different functions in the body, their basic structure is the same. Most cells have three parts:

- the nucleus, composed of the genetic material called DNA;
- the cytoplasm, containing specialized structures to give each cell its particular characteristics, and
- the membrane, or skin, that regulates the entry of food and chemicals from the blood and the elimination of waste products.



Cell Damage

The remarkable and complex substance we call DNA contains a kind of blueprint for the reproduction and specialized function of the cell. Damage to the DNA causes abnormal growth or abnormal function.

Human exposure to hazards like ionizing radiation and some mutagens (substances capable of changing genetic structure) can result in cell damage. These agents may cause changes in the DNA, with the result that new cells experience abnormal growth or function improperly.

Many chemical and physical agents are known or suspected to be **carcinogens**, **mutagens**, or **teratogens**. Others can cause a variety of health and safety problems where their exposure is not controlled.

CARCINOGEN: a substance or physical agent that can cause cancer in humans. Asbestos, bis-chloromethyl ether (B.C.M.E.), beta-napthylamine are examples of carcinogens. Asbestos and B.C.M.E. cause lung cancer. Coal tar from coke oven emissions can cause cancer in many parts of the body.

MUTAGEN: a substance or physical agent that can cause changes in one or more hereditary features by modifying genes. Ionizing radiation is a mutagen.

TERATOGEN: a substance capable of causing changes to the developing fetus (the baby in the womb). The drug Thalidomide is a well known teratogen.

All three described above are believed to have at least one common factor. They cause abnormalities in the DNA, which is the pattern for the creation of new life.

Carbon monoxide (from vehicle exhaust fumes) and cyanide are two examples of toxic gases or chemicals which can affect the normal functioning of proteins in the cytoplasm, causing toxic effects. Cyanide ions in the blood reduce its ability to absorb oxygen which is constantly needed by the body.

Harmful substances may enter the body and cause adverse health effects for a number of reasons:

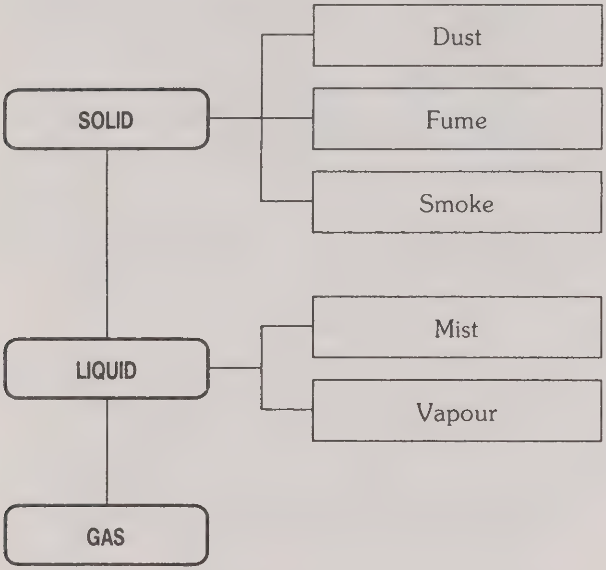
- the material is so toxic it overpowers the body's defence system;
- the body's defence system is defective;
- no defence mechanism exists for some substances;
- the defence mechanism over reacts to the substance and creates a byproduct which results in disease.

DOSE

An important point to remember is that any substance can become toxic if the dose is, increased beyond the body's tolerance limits. Oxygen, which is critically important for life at 21% of air level, can become toxic at 100% level. Therefore, the strength of the dose of a toxic chemical or physical agent determines the extent of the harmful effect.

PHYSICAL STATES

Hazardous substances in the workplace can be found in the following forms:



DUSTS: are usually generated by mechanical action on a solid (e.g. grinding, crushing, handling). Fine particles of dust can remain suspended in air, larger particles are heavy enough to settle to the ground rapidly. An example of a dust generating operation is surface grinding.

FUMES: are finely divided solid particles associated with molten metals or plastics. A fume is formed when a volatized solid, such as metal, condenses in cool air. This occurs in welding operations.

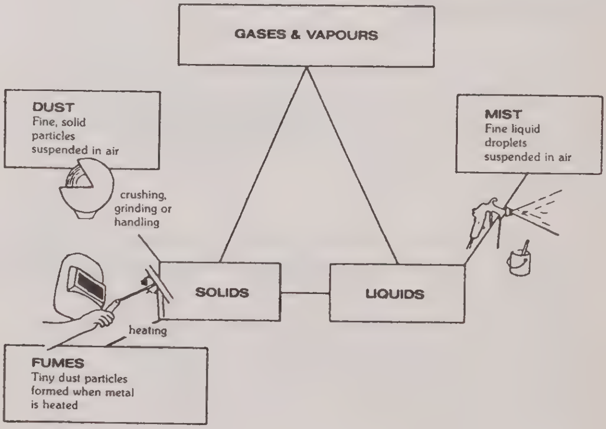
SMOKE: is formed when a material containing carbon is burned. Smoke generally contains droplets as well as dry particles.

MISTS: are suspended liquid droplets formed when gases condense into liquid state or by breaking up a liquid by splashing, foaming or atomizing. Examples of mists are acid mist from electroplating, oil mist from cutting or grinding, paint mists from spray paint operations.

VAPOURS: are the gaseous forms of substances which are normally in the solid or liquid state. Substances such as toluene, ether, or alcohol evaporate and create vapours. Vapours may be found at operations using cleaning agents and paint thinners.

GASES: are substances that do not exist as a solid or a liquid at room temperature and pressure. Gases tend to spread out and occupy entire space or enclosure they are in. Examples include carbon monoxide, methane and oxygen.

PHYSICAL STATES AND FORMS



All these different forms can contaminate the workplace are.

B. ROUTES OF ENTRY

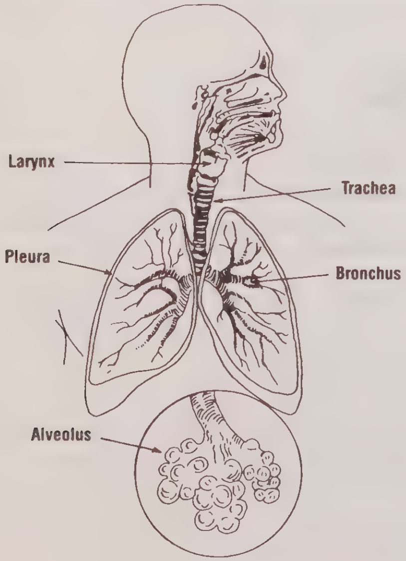
Hazardous materials in the workplace may cause disease in the body at four main sites:

- where they enter the body — entry routes such as the lungs, skin and intestines;
- in the blood that carries them throughout the body;
- in the central nervous system; and
- in the organs which have the ability to concentrate toxicants and remove them from the body: i.e., the liver, kidneys and bladder (exit routes).

This section briefly describes the three common routes of entry: inhalation, absorption and ingestion, and some of the workplace hazards and diseases commonly associated with them.

INHALATION

The body's respiratory or breathing system is one of the most important routes of entry for a toxic substance. The substance may cause damage to the system itself or it can pass through the lungs to other parts of the body. The main function of the respiratory system is to absorb oxygen from the air and pass it on to the blood. It also removes carbon dioxide, the waste gas produced by the body's processes from the blood, and releases it in exhaled air.



Air reaches the lungs through a branching system of tubes, starting with the trachea, or windpipe, which divides to form two bronchi, one to each lung. Each bronchus, in turn, branches into many smaller divisions, finally ending in a cluster of tiny air sacs which are known as alveoli. There are about one hundred thousand of these air sacs in each lung. The oxygen and carbon dioxide exchange takes place through a very thin membrane surrounding the air sacs.

Although they have the same basic structure as other cells, the cells lining the alveoli are extremely thin and well supplied with blood. This allows the oxygen from the air to pass readily into the small blood vessels in the wall of the air sacs. Naturally, other substances in the workplace air can gain access to the bloodstream by this route. For example, dusts that are able to reach the alveoli can cause scarring of the lung. The general term for such scarring is pneumoconiosis; meaning "dust disease of the lung." (Gases and vapours from acids and caustics can also produce scarring of the lung but do not pneumoconiosis.)

The lung is covered by a delicate lining known as the pleura. Mesothelioma, one of the cancers caused by asbestos, is a cancer of the pleura.

Table 1 lists some of the more common diseases caused by dust in the lungs.

TABLE 1

Lung Diseases Caused by Dusts	
Asbestosis (Asbestos)	Black Lung (Coal)
Silicosis (Silica)	Byssinosis (Cotton)
Berylliosis (Beryllium)	Shaver's Disease (Bauxite)
Siderosis (Iron)	Bartitosis (Barium)
Stannosis (Tin)	

How hazardous materials evade the lung's defences:

The airways of the respiratory system have developed an elaborate system of defences which trap all but the smallest dust particles. This system consists of hairs in the nose and mucous in the trachea or bronchi. The mucous is produced continuously by special cells in the walls of the larger airways. It is moved upwards and to the back of the throat by the whipping action of tiny, hair-like projections known as cilia on the cells of the trachea and bronchi. In the course of a day, each of us produces and unconsciously swallows about one litre of mucous.

Large dust particles are trapped in the mucous and are either swallowed or spit out. Particles smaller than 0.5 micron (l inch has 25,400 microns) may remain airborne and are exhaled. The most dangerous size range of dust particles is between 0.5-7 microns. Much too small to be seen with the naked eye, they can evade the defence system and reach the lungs. Once in the lungs, these tiny particles of dust may cause extensive scarring of the delicate air sacs. This scarring starts the disease process which produces severe shortness of breath.

Most dust particles are too large to pass through the walls of the alveoli, but gases, vapours, mists and fumes can all enter the bloodstream through the lungs. In addition, welding fumes, acid mists or truck exhausts can stimulate the lung's defences to produce large amounts of phlegm, causing the crippling condition known as chronic bronchitis. These same types of substances can destroy the delicate air sacs of the lungs, causing emphysema.

Because the lungs are in such intimate contact with so many pollutants in the workplace air, they are the prime target for occupational carcinogens. Table 2 lists some of the materials which are known to cause lung cancer.

TABLE 2

Agents Known to Cause Lung Cancer

Acrylonitrile Coke	Oven Emissions
Arsenic	Hematite Iron
Asbestos	Ionizing Radiation
Benzo (a) pyrene	Isopropyl Oil
Beryllium	Leather Dust
Bis Chloromethyl	Mustard Gas
Ether	Nickel
Cadmium	Radon Gas
Chromium	Vinyl Chloride
Cigarette Smoke	

ABSORPTION

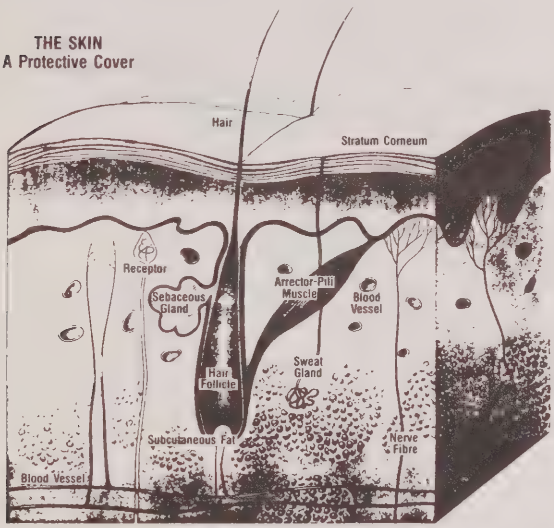
Absorption through the skin is another common form of entry for toxic substances (i.e.: organic solvents). The skin is the largest organ of the body and has the largest surface area that can come into contact with harmful substances. Some chemicals can penetrate through the skin, reach the blood stream and get to other parts of the body. Aldrin and Acrylamide are examples of chemicals which are absorbed through the skin. Mineral spirits and other solvents used in the manufacture of paint can easily penetrate the skin.

The Skin

The skin protects the internal organs of the body from the outside environment. Its outer layer is composed of hardened, dead cells which make the skin resistant to daily wear and tear. Sweat glands cool the body when the environment is hot. Sebaceous glands produce oils that repel water. A network of small blood vessels, or capillaries, plays a key role in controlling body temperature. These capillaries open when it is hot, radiating heat outward into the air, and constrict when it is cold, conserving heat in the body. The skin also has a protective layer of oils and proteins that helps prevent injury or penetration by harmful substances.

A substance may be absorbed and travel to another part of the body, or it may cause damage at the point of entry (the skin), and start the disease process. Such substances are usually identified in a MSDS with a "S" notation along with their exposure limits, indicating that the exposure can occur through the skin, mucous membranes or eyes, or may damage the skin itself.

THE SKIN
A Protective Cover



Industrial skin diseases account for 50 to 75% of all compensation claims for occupational diseases.

DERMATITIS is an inflammation of the skin which can be caused by hundreds of workplace substances like solvents (paints), epoxy resins acids (plastic manufacturing), caustic substances and metals (metal plating). Dermatitis shows up as redness, itchiness or scaling of the skin. There are two types of dermatitis:

- primary irritation dermatitis (contact dermatitis), and
- sensitization dermatitis (allergic dermatitis).

PRIMARY IRRITATION DERMATITIS is caused by friction, heat or cold, acids, alkalis, irritant gases and vapours. Brief contact with these agents in high concentrations or prolonged repeated contacts in low concentration will cause inflammation.

SENSITIZATION DERMATITIS, on the other hand, is the result of an allergic reaction to a given substance. Sensitization may be the result of prolonged or repeated contact and becomes established usually within 10 to 30 days.

Once sensitized, even a small exposure can produce severe reaction. Substances like organic solvents (paints), chromic acid and epoxy resins can produce both primary and contact dermatitis. Plastic makers, resin makers, door makers (TD1 Foam), refinery workers and farmers are often exposed to sensitizers.

Table 3 lists materials which are common causes of industrial (contact) dermatitis.

TABLE 3

Common Causes of Industrial Contact Dermatitis	
Acrylics	Nickel
Chromates	Polyurethane
Epoxy Resins	Thiurans
Formaldehyde	

Some hazardous materials used in the workplace have been linked with skin cancer. A number of them are listed in Table 4.

TABLE 4

Some Workplace Causes of Skin Cancer

Pitch	Carbon Black	Ultraviolet Light
Asphalt	Tar	X rays
Creosote	Benzo(a)pyrene	Anthracene
Shale Oil	Cutting Oils	Soot
Arsenic		

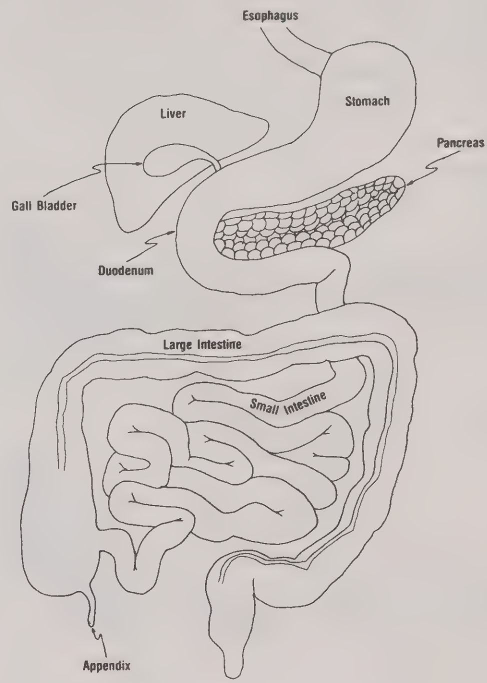
INGESTION

A third major route of entry for toxic substances is through the mouth and digestive tract. Toxic materials may reach the stomach when food is eaten or cigarettes are used in a dusty work area, when clean lunchrooms are not provided, when workers fail to wash their hands before eating or smoking, or when food is left unwrapped in a dusty place. Lead dust from battery crushing or linotype printing is easily ingested in this way, and can have serious health effects. Once swallowed, the substances enter the digestive tract, and may enter the blood stream.

The digestive tract is a continuous tube that extends from the mouth to the anus. The organs of the digestive system provide the means of ingestion, digestion and absorption of food. Almost all digestion and absorption of food and water takes place in the small intestine. The large intestine generally absorbs vitamins and salts.

Once swallowed, the toxic substances enter the digestive tract, where they may enter the blood stream and move on to the liver. The liver tries to remove the poisons and make the substance less harmful to the body, but is not always successful.

NOTE: Toxic substances may also enter the body by injection. For instance, hospital employees working with contaminated syringes may accidentally inject viruses into patients' bodies.



C. THE CIRCULATORY SYSTEM

The circulatory system is usually not in direct contact with hazardous materials as are the lungs, the skin and the digestive system. Once in the bloodstream, however, harmful substances can be transported to any part of the body.

The centre of the circulatory system is the heart. It pumps blood outward through a vast network of blood vessels which branch like a tree, becoming smaller and smaller as they do so. The vessels branch so extensively that no cell is more than a few millimetres from a blood vessel or capillary.

Hazards to the Circulatory System

Food and oxygen reach every cell in the body through capillaries, but so do toxic substances from the workplace. Oxygen is carried by a protein called hemoglobin, which is contained in the red blood cells. Oxygen binds strongly to hemoglobin, but unfortunately, so does carbon monoxide, a common workplace hazard produced by combustion engines in buses, trucks, machinery, etc. In fact, carbon monoxide binds or attaches to hemoglobin about 200-300 times more readily than oxygen.

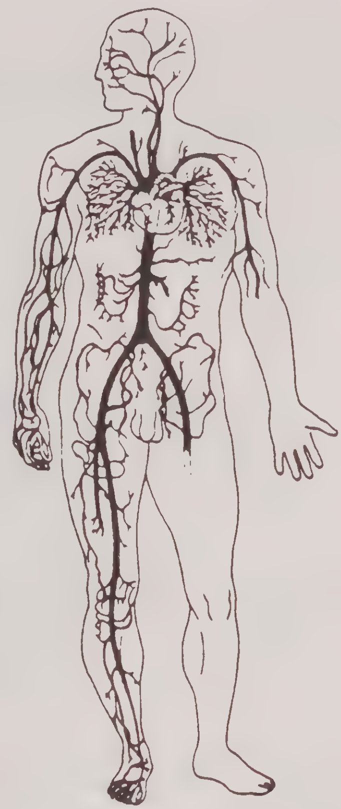
In high concentration, carbon monoxide kills, because it overloads the hemoglobin in the red cells and replaces the oxygen which the body needs to survive. But even low levels of repeated carbon monoxide exposure may have serious effects on the heart and the central nervous system.

Many toxic substances attack the blood cells directly. The body forms blood cells continuously in the marrow cavity inside the bones. Hazardous materials like benzene used in the rubber industry interfere with this formative process and cause anemia, a shortage of red blood cells. Table 5 lists some of the materials known to cause anemia.

TABLE 5

Some Substances Causing Anemia

Arsine Gas	Cadmium
Selenium	Copper
Lead	Gallium
Stibine	Mercury Compounds
Beryllium	Benzene
	Toluene



D. ROUTES OF EXIT AND DISEASE SITES

We have reviewed the main routes of entry into the body for hazardous substances. We have also seen examples of how these substances interfere with normal body functions and start a disease process. In this section we will look at the functions of some major organs like the liver, the kidneys and the nervous system. We will see how they deal with and detoxify chemicals and get them out of the body, and how their normal functioning can be damaged by hazardous materials in the workplace.

The Liver

The liver is the chemical factory of the body. The cells which make up the liver contain enzymes which can convert certain toxic substances into forms that are more easily handled by the body. But the liver itself may be damaged in the process if it is forced to deal with substances which overwhelm it.

The liver may become inflamed, producing the condition known as HEPATITIS. This disease may be caused by a virus or by chemicals like alcohol, carbon tetrachloride and other chlorinated hydrocarbons such as used in the dry cleaning industry. Repeated bouts of hepatitis may lead to liver scarring called CIRRHOSIS of the liver. Generally speaking, it means that there is not enough normal liver left to detoxify body chemicals. Cirrhosis may lead to harmful effects on the brain.

Over exposure to chemicals like acrylonitrile, benzene, carbon tetrachloride, D.D.T., chloroform, phenol, styrene, tetrachloroethane and tetrachloroethylene found in the chemical industry may cause liver damage.

TABLE 6

Substance Causing Liver Damage

Antimony	Acrylonitrile	Ethylidene Dichloride
Arsine	Benzene	Hydrazine
Beryllium	Carbon Tetrabromide	Methyl Alcohol
Bismuth	Carbon Tetrachloride	Methyl Choride
Cadmium	Chlorinated Benzenes	Methylene Dianiline
Copper	Chloroform	Naphthalene
Indium	Creosol	Phenol
Manganese	DDT	Pyridine
Nickel	Dimethyl Sulfate	Styrene
Phosphorus	Dioxane	Tetrachloroethylene
Selenium	Epichlorohydrin	Toluene
	Ethyl Alcohol	Trichloroethane
	Ethylene Chlorohydrin	Trichloroethylene

Vinyl chloride, a substance used in the production of plastics, has been linked with a rare and deadly form of liver cancer called angiosarcoma.

The Kidneys and Bladder

The kidneys act as a filter to all substances in the blood. They are located near the back, just below the rib cage. Each kidney is about 5 inches long and 2 inches wide and contains over a million small filters. These filters clean the blood, removing a number of impurities which they deposit in the urine. The urine then passes to little tubes called TUBULES, which monitor the levels of acid and the amount of water in the body, and keeps them balanced. From the tubules, the urine moves to the BLADDER, which controls its outlet from the body.

Since the kidneys act as filters to all substances in the blood, they can be seriously injured by toxic substances passing through the body. Kidney disorder may result in high or low blood pressure, which in turn may cause heart strain or heart failure. Kidney malfunction may upset the body's delicate chemical balance and may result in further harm to the body.

Just as the lungs are vulnerable to hazardous materials because they are a major route of entry, the kidneys and bladder are vulnerable because they are the major route of exit.

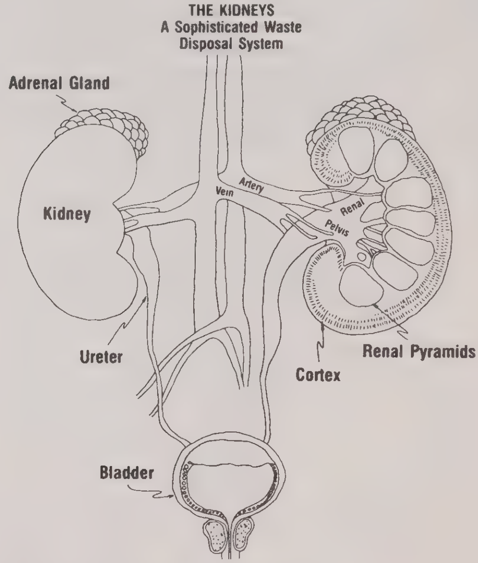


Table 7 shows some of the materials known to cause kidney damage.

TABLE 7

Agents Causing Kidney Damage

Lead	Naphthalene
Mercury	Carbon Tetrachloride
Cadmium	Tetrachloroethane
Chromates	Carbon Monoxide
Copper	Gasoline Vapours
Uranium	Turpentine
Beryllium	Bismuth
Arsenic	Oxalic Acid
Arsine	Intense Heat
Sodium Fluoride	Vibration
Iodine	High Voltage Shocks
Carbon Disulfide	Blood Loss

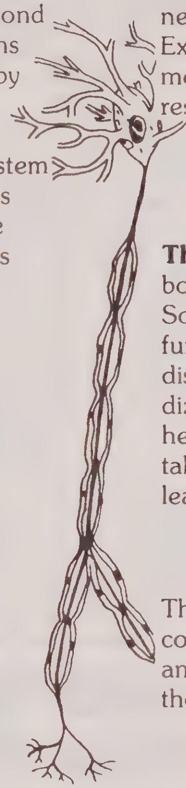
THE NERVOUS SYSTEM

To stay alive, we must breathe continuously, our heart must pump constantly and all the other organs must function. We also think and respond to emotions and sensations. All these functions performed by mind and body are controlled by the nervous system.

As the name suggests, the central nervous system is the control centre. The spinal cord connects the brain to the nervous system. A part of the nervous system reaches the outer areas and is called the peripheral nervous system.

TABLE 8

Some Chemicals That Affect the Nervous System			
Depression of Central Nervous	**Brain Poisoning**	**Brain Damage by Oxygen Deprivation**	**Nerve Function Disorders**
Acetates	Carbon disulfide	Asphyxiating gases	Organo-phosphate pesticides
Alcohols	Hydrogen cyanide	Carbon monoxide	Organo-phosphate plasticizers
Brominated chemicals	Hydrogen sulfide		Heavy Metals
Chlorinated chemicals	Stilbene		Mercury
Ethers	Arsine		Lead
Ketones			Manganese
			Arsenic



Most injuries of the central nervous system are permanent, although damage to the peripheral nervous system can sometimes be reversed. Exposure to pesticides and metals like lead and mercury may interfere with nerve impulses and result in tremors and loss of reflexes or feeling.

The brain is a very delicate and vital part of the body. It needs a constant supply of oxygen. Some toxic chemicals interfere with the functioning of the central nervous system and disrupt the oxygen supply. The first warning is dizziness and drowsiness. This warning should be heeded immediately and appropriate action taken; for example, you should immediately leave the area and ask for medical assistance.

The operations of the nervous system are very complicated. It is a delicately balanced system and several chemicals can damage it, such as those shown in Table 8.

E. THE REPRODUCTIVE SYSTEM

We have discussed how workplace hazards affect the worker, but the problem reaches into the worker's home as well.

The reproductive organs, the testes in men and the ovaries in women, produce the cells that allow us to reproduce. Any damage to these cells can have disastrous consequences. Deformities in children may result, or the developing embryo may be so severely damaged that it is unable to survive and is miscarried. Female anesthetists and nurses who work in operating rooms have twice as many miscarriages as other women, because of their exposure to anaesthetic gases. Male workers exposed to lead or to the pesticide dibromochloropropane (DBCP) suffer from reduced sperm counts which make them less fertile.

Some chemicals cause miscarriages or birth defects by attacking the genetic material of the cell or the systems which control its functions. Similar damage may also be involved in cancer, and thus, cancer-causing substances are often the cause of birth defects and miscarriages.

Environmental factors influencing the reproductive system in humans

Factors	Reduced fertility	Miscarriages	Chromosomal damages	Malformations	Sperm damages
Anaesthetic gases	♂	♂♀		♀	
Benzene	♂		♂♀		
Mercury		♀		♀	
Epichlorohydrin			♂♀		
Ethylene dibromide	♂				
Ethylene oxide		♀	♂♀		
Glutaraldehyde		♀			
Ionizing radiation	♀	♀	♂♀	♀	
Chloroprene	♂	♂			♂
Lead	♂♀	♀			♂
Organic solvents	♂	♀	♀	♀	
Carbon disulphide	♂	♀			
Vinyl chloride		♂	♂		

Legend:
♂ = Male exposure
♀ = Female exposure

Source: Finland's Institute for Occupational Health, Helsinki 1982.

F. LATENCY, ACUTE AND CHRONIC EFFECTS OF WORKPLACE HAZARDS

The effects of exposure to workplace hazards are sometimes immediate, painful and obviously damaging, but it is not always easy to observe when and how the body's cells are attacked by a hazardous material at the workplace. Many of the most serious diseases do not occur until 10 to 30 years after exposure.

LATENCY OF WORKPLACE DISEASE

Latency refers to the time lag between exposure to a hazardous material and the eventual development of a disease. For many occupational hazards, the latency period is a minimum of ten years and an average of twenty years or more. It may be as long as thirty or even forty years. The latency period does not refer to the total duration of exposure to a substance, but to the time that has elapsed since first exposure. Most occupational diseases reported to the Workers' Compensation Board have short latencies; for example, chemical burns and welders' flash.

Latency has a number of important implications for the worker. An individual exposed to a highly dangerous substance may feel no ill effects at the time of exposure. The effects may only show themselves many years later. For instance, exposure to ionizing radiation or asbestos causes very little in the way of symptoms at the time of actual exposure, but the long term effects are deadly.

Past scientific studies have often failed to address the problem of latency in evaluating the incidence of a disease. By studying only the current work force (including many workers who have worked in a particular environment for less than twenty years), the researchers fail to detect the presence of serious problems such as asbestosis.

Finally, a workplace free of disease is not necessarily a workplace free of hazards. What is seen as disease today, generally reflects the working conditions of several decades ago. In the same way, the workplace hazards of today may produce the health problems of the twenty-first century.

ACUTE AND CHRONIC EFFECTS OF WORKPLACE HAZARDS

Workplace hazards may have both immediate and long-term effects on the body. These are termed acute and chronic effects. The sudden collapse of a worker who has been exposed to massive doses of carbon monoxide, or the headaches of a secretary working in a poorly ventilated office, are examples of acute effects.

The acute effects of toxic substances occur immediately or very soon after the worker's exposure, and are generally caused by high levels of exposure. They may cause death, but are often treatable if caught quickly. They are sudden and dramatic, and result from the direct action of the hazardous material on the cells of the body.

Much more serious however, are the chronic effects of toxic substances. Chronic effects become apparent only after many years. By and large, they are not treatable. They often result from the body's attempts to repair itself, or to compensate for the acute effects of a substance. For example, cancer is a chronic effect, as is the lung scarring caused by silica dust, or the hearing damage caused by noise. Chronic disease becomes evident only after severe damage has occurred.

The acute effects of a hazardous material are usually very different from the chronic effects. Table 9 illustrates the difference between the acute and chronic effects of some of the hazards discussed earlier in this Module.

TABLE 9

Acute and Chronic Effects of Some Common Workplace Hazards

	Acute	**Chronic**
Acid Mists	Irritation of the eyes and throat, watering of the eyes, cough, sore throat, chest pain	Chronic bronchitis and emphysema
Asbestos	Mild respiratory irritation, cough, sneezing	Asbestosis, cancer of the lung, pleura, and larynx, stomach and intestines
Carbon Monoxide	Drowsiness, headache, confusion; in very high amounts, unconsciousness and death	Heart attacks and strokes
Trichloroethylene	Light-headedness, euphoria, "drunken" feeling, numbness	Liver and kidney damage; possibly liver cancer
Vibration	Tingling and stiffness in the joints	Arthritis, tendonitis

The exposure limits for various hazardous materials have been developed to protect workers but should not be treated as a fine line between safe and unsafe workplaces. It is understood that not all individuals react in the same manner to the same amount of harmful material. Therefore, efforts to reduce workers exposures should ideally start at half the exposure limit. This is known as the "action level." Level of workers' exposures should be reduced to the lowest practical level achievable.

CONCLUSION

Workplace hazards are a concern of employers, employees and governments. This module was designed to improve workers' knowledge and understanding of how the human body functions and how over exposure to harmful substances can start the disease process.

The next module "Control and Emergencies" describes how to protect yourself from other occupational hazards.

***NOTE:**
Tables developed or copied from:

Daum, S.M.; Stellman, J.M., *Work is Dangerous to Your Health*, Vintage Books, New York, NY, USA, 1971

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REVIEW QUESTIONNAIRE

This questionnaire will help you and your group to review selected information covered in your training.

1. The cell consists of:

a. hemoglobin
b. nerve fibre
c. cytoplasm
d. dermis
e. nucleus
f. capillaries
g. germinal layer
h. membrane

2. The circulatory system consists of:

a. hemoglobin
b. heart
c. cytoplasm
d. blood
e. lungs
f. capillaries
g. germinal layer
h. blood vessels

3. What are the main sites of the body where hazardous substances cause disease?

a. hands	g. nose
b. liver	h. feet
c. mouth	i. lungs
d. bladder	j. kidney
e. intestines	k. skin
f. blood	l. nerves

4. Match the words with the proper definitions.

a. acute	substance which damages the DNA of sperm in men or ova in women.
b. chronic	the concentration in air at which a substance can be detected by smell.
c. sensitization	a substance which causes birth defects by damaging the developing fetus.
d. latency	effects occuring immediately or very soon after exposure.
e. DNA	the time period between first exposure to a substance and the appearance of disease.
f. mutagen	effects occuring long after exposure to a substance.
g. teratogen	the body's overreaction in defending against hazardous substances.
h. leukemia	a complex chemical blueprint for growth and development that forms the genes and chromosomes found in the nucleus of cells.
	the lowest concentration of the substance which causes irritation.
	cancer of the lining of the lung, or pleura, almost exclusively linked to exposure to asbestos.
	a general term for a group of diseases resulting from the uncontrolled growth of abnormal cells.
	cancer of the white blood cells.

APPENDIX 'A'

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WHMIS

RIGHT TO KNOW

CONTROL OF HAZARDS

Participant Guide

June, 1988

MODULE FOUR B

TERMINAL OBJECTIVES:

At the end of this module, the participant will have an awareness of:

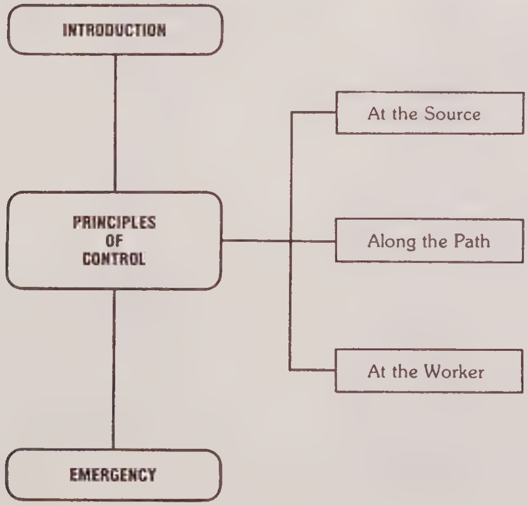
1. The purpose of the legislation in ensuring the provision of information on hazardous materials in the workplace for the protection of worker health and safety.
2. The provisions of the amended Occupational Health & Safety Act.
3. The inter-relationship of Bill 79 and the federal Hazardous Products Act & Regulations and Hazardous Materials Information Review Act & Regulations in implementing WHMIS (the Workplace Hazardous Materials Information System).

PERFORMANCE OBJECTIVES:

At the end of this training session, the participant will be able to:

1. **Identify** legislation governing the provision of hazardous materials information in the workplace.
2. **State** the purpose of amendments to the O. H. & S. Act.
3. **Define** the key classes of hazardous materials covered by the Controlled Products Regulations.
4. **Explain** the responsibilities of the employer with respect to:
   a) hazardous materials
   b) hazardous physical agents
5. **Identify** the general duties of the worker as they apply to hazardous materials.
6. **Recognize** the provisions for protection of trade secrets (confidential business information) and appeals.
7. **Recognize** the enforcement procedures and penalties for non compliance.

FLOWCHART



CONTROL OF HAZARDS

INTRODUCTION

Occupational health and safety is a workplace problem, therefore, solutions must be found in the workplace. This means the elimination of any worker exposure to harmful substances which might be caused by normal workplace processes, or work routines, or other regular practices.

EMERGENCY is an unusual or unplanned event which may lead to worker exposure to any harmful substances if it is not brought under control rapidly and efficiently.

PRINCIPLES OF CONTROL

A workplace hazard can be controlled in many different ways, depending on the nature of the hazard and on the work process that causes it. A particular workplace process may produce more than one hazard, so the best control method will usually be one that has been tailored to that process.

Each control measure must meet several requirements:

1) **It must adequately control the hazard.** In designing the control method, an effort must be made to eliminate any exposure to the hazard. For example, if the hazard is a gas which displaces oxygen (also called an asphyxiant), exposure must be reduced to a level that causes no danger to the worker.

2) **It must allow workers to do their jobs without undue discomfort or distress,** and must not create new hazards of it own. For example, a worker with heart or lung disease may suffer serious health problems from the use of a respirator, because it makes breathing more difficult. Respirators should only be used as a last resort.

3) **It must protect every worker who might be exposed to the hazard.** A respirator might provide adequate protection for a construction worker removing asbestos, but the dust can injure the health of a nearby electrician who has not been issued a respirator.

4) **It must not create a hazard in the surrounding community.** A ventilation system that pushes toxic substances into the outside atmosphere without first cleaning the exhaust air is only spreading the problem.

We can apply these requirements with best results by finding the most effective place to apply the controls:

A. at the source, where the hazard begins;
B. along the path of the hazard to the worker;
C. at the worker.

The most effective control measure is the one applied at the source. Controls tend to be less effective the farther away they are from the source of the hazard.

A. CONTROL AT THE SOURCE

Control of a hazard at its source means that it is:

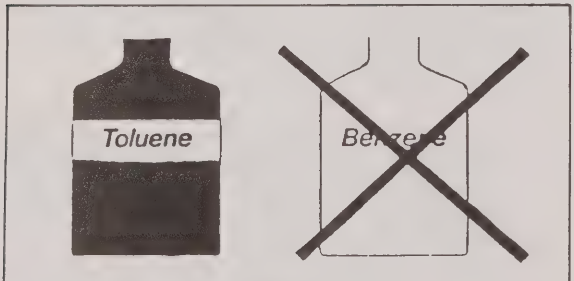
- eliminated from the workplace altogether; or
- isolated completely from the worker.

It is by far the best method of control, and is the only method acceptable for control of carcinogens (cancer causing substances).

Elimination

The easiest way to completely eliminate a hazard from the workplace is by the substitution of a safer substance or process. Substitutes must be found for carcinogens like benzene.

For example, benzene can be replaced by the non-carcinogenic (non-cancer causing) compound, toluene, in lacquers and paint removers, or by aliphatic hydrocarbons (petroleum derivatives such as Stoddart Solvent) in glues or cements. Benzene need never be used as a solvent because safer substitutes are available.



SUBSTITUTION

There are other examples of substitution. Sandstone grinding wheels which give of toxic silica dust, can be replaced by less toxic aluminum oxide wheels. The danger of silicosis, the disease caused by silica dust in the lungs, can be avoided by the use of steel shot instead of sand for abrasive blasting (sandblasting), or by the substitution of non-silica parting compounds in foundries. Paint pigments can be produced with zinc or titanium oxides instead of lead oxides.

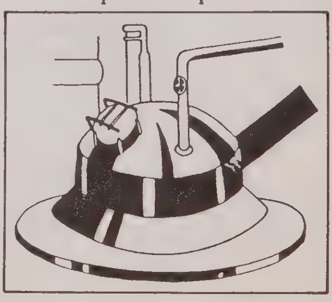
Control or elimination of a hazard by substitution is highly effective, and there are many more examples of hazards which can be completely eliminated from the workplace by this means. It should be the first method used in the attack on any serious workplace health hazard.

Safer is Not Necessarily Safe: A substitute may be safer than the substance eliminated, but not entirely safe itself. Care must still be taken. Although toluene can be used in place of benzene, it is by no means hazard-free. It may be contaminated with benzene. In high concentrations it may cause liver damage and lightheadedness, or unconsciousness. The reason for its use as a substitute for benzene is that unlike benzene, it is not a cancer-causing substance. Nevertheless, adequate ventilation should be provided wherever toluene is used.

Fibreglass, which has been used as a substitute for asbestos, must also be treated with caution. Animal studies have shown it to cause some of the same cancers already traced to asbestos. Cases of cancer from exposure to fibreglass have been recorded in humans. In the last ten years, methods of using fibreglass have produced fibres small enough to get past the body's defences and reach the lungs. Fibreglass is therefore not an acceptable substitute for asbestos.

Isolation

This method of control at the source may involve redesigning the work process, the installation of new equipment, the addition of safety features to existing machinery, or even the complete elimination of a hazardous step in the production process. These kinds of changes are often called "engineering controls".



Closing or isolating the whole process that gives rise to the hazard is a form of isolation that requires engineering or a redesign of some kind. An example may be seen in the closed vat (or closed kettle) systems used in the chemical industry. They have reduced exposures to such carcinogens as vinyl chloride and bis chloromethyl ether (BCME). These forms of isolation should be used for any highly toxic or cancer-causing substance if it cannot be eliminated by substitution.

Enclosed systems must be carefully maintained and monitored, because even small leaks can result in dangerous concentrations of the material in the surrounding air. Maintenance workers must be supplied with protective clothing and equipment that completely isolates them from this hazard during cleaning and repair. In addition, closed kettle systems should be equipped with sensitive alarms that are triggered if any detectable amount of the substance starts escaping into the workplace.

For substances that must be manipulated by hands, negative-pressure glove boxes equipped with their own ventilation systems can be used. These allow the mixing or pouring of toxic materials by hand, with minimal risk to the worker.

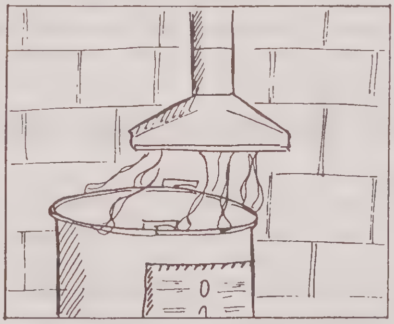
Isolation by remote control is a further development of the same control principle. Mechanical devices are available which can perform simple procedures such as lifting or pouring under the control of an operator who is safely removed from exposure. In some cases, these mechanisms are under control of an automated device which is supervised by the operator. Environmentally-protected (air conditioned) control rooms or operators' cabs can be used to isolate the worker from a dangerous environment. A combination of these methods, used in the Japanese steel industry, has almost completely eliminated worker exposure to carcinogenic coke oven emissions.

B. CONTROL ALONG THE PATH

Examples of control along the path taken by the hazard are **local ventilation** close to the source and **general ventilation** along the entire path. Both methods may be necessary in a smelter where molten material emits hazardous gases while being moved from one point to another in the smelting process. There are also other kinds of control along the path. The closer the control is to the source of the hazard, the better the control system.

Ventilation

Local ventilation systems include fixed hoods over soldering benches, in laboratories, beside foundry forges or above smelter convertors. Movable hoods and ducts in welding operations and paint spray booths are further examples of local ventilation. A properly designed and maintained local ventilation system can be an extremely effective means of controlling airborne hazards in the workplace.



General ventilation, sometimes called dilution ventilation, simply spreads a toxic substance throughout the entire volume of air in a workplace, thereby decreasing the concentration of the substance. This method of control along the path is only suitable where less dangerous materials are released in small amounts into a large volume of air. This kind of ventilation is commonly encountered in industry, but it simply spreads the toxic substance throughout the workplace.

Barriers

Portable barriers or screens may provide some worker protection against energy hazards like heat, noise, sunlight and some forms of ionizing radiation. Reflective shielding will reduce the heat levels experienced by those working near furnaces or boilers. Power-line workers and electrical mechanics must be provided with a rubber line hose, insulator blankets or other barriers to prevent contact with live equipment. Lead screens will protect workers from stray radiation where x-ray equipment is in use.

Housekeeping

General housekeeping measures are another kind of control along the path. They include proper cleaning of the workplace, disposal of wastes and clean-up spills. Vacuum cleaners should be used instead of brooms or mops whenever possible, because they remove the substance from the workplace while brooms and mops may stir it up, allowing it to spread into the air and be inhaled by the worker. The use of air hoses to clean machinery should be avoided for the same reason.

Wet methods can be used to control a hazard along its path. Dusts from blasting, grinding, crushing and drilling operations are mixed with water. Though wet methods substantially reduce the amount of dust in the air, they are not completely effective. They are best used in conjunction with other methods of control such as local ventilation.

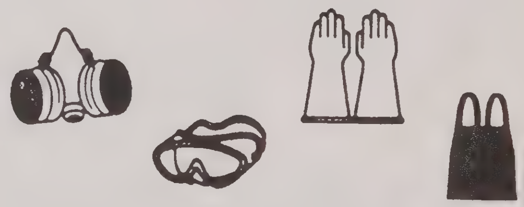
C. CONTROL AT THE WORKER

Control at the worker is the least satisfactory control method because it is applied farthest from the source and does not eliminate the hazard from the workplace. There are two kinds of worker control. **Personal protective equipment** and **administrative controls** are both examples of hazard control at the worker.

Personal Protective Equipment

Most health and safety laws in Canada recognizes that personal protective equipment should be used only in special circumstances and for limited periods of time. The outfitting of workers with protective gear should **not** be the first approach to worker protection from workplace hazards.

Personal protective equipment is, in most cases, cheaper and easier to provide than engineering changes such as enclosure, isolation or ventilation. However, the use of personal protective equipment may prove far from simple or cheap in the long run. Personal protective devices are seldom properly tested, fitted or maintained. As a result, they may actually endanger a worker by providing only the illusion of safety

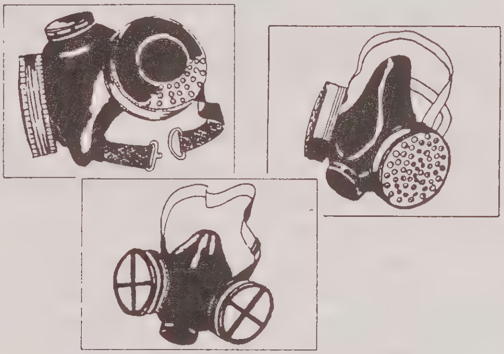


Some jobs require the use of personal equipment such as **glasses or goggles, boots, gloves or special clothing**. It is important to remember that there is usually no type of glove or clothing that protects against every substance in the workplace. Each must be chosen for the particular hazard involved in the worker's job.

Some substances can pass through gloves or clothing long before any cracks or holes appear, and gloves and clothing need regular inspection and replacement as a result of wear. Workboots present a similar problem. A hazardous substance may be absorbed into the worker's body through the feet if boots become soaked with it.

Regular use of **respiratory protection** (breathing protection) is required on some jobs, but before assignment, the worker should receive medical counselling and respiratory testing from an independent source. The worker should also

receive special training on the use, care and cleaning of respirator. The respirator must be carefully selected to ensure it is the proper type for the particular hazard and length of exposure. Respirators need routine maintenance and cleaning, and their cartridges and filters must be regularly replaced.



It is difficult to assess the effectiveness of respirators against the full range of conditions to which its wearer may be exposed on the job. Thus, respirators may end up creating unexpected additional hazards. They are often uncomfortable and make job performance more difficult, in part, at least, because they make it harder for the wearer to breathe and for his/her voice to be understood. For all these reasons, respirators should only be used after all other control measures such as substitution, isolation and ventilation have been put in place to reduce hazardous chemical exposures as far as practically possible.

The accepted role of respirators is as a temporary measure when other controls are not available, or not working, or in emergencies. Better technologies exist for making the workplace safe, and they should be used.

Administrative Controls

Administrative controls are those rules and procedures which control the worker rather than the hazard. They may include such measures as pre-screening workers and not hiring those who are abnormally sensitive to a particular workplace hazard. Another example of administrative controls includes rotating shifts in hazardous areas to reduce average exposure levels.

In some circumstances, administrative controls may be necessary. The cleaning and maintenance of closed chemical vats can release enormous amounts of toxic material and should therefore only be carried out on weekends, at nights or during shutdowns when as few workers as possible will be exposed to the hazards. Administrative controls do not control workplace problems, they merely impose limits on who shall be exposed and for what length of time.

EMERGENCY PLANNING

A leading North American insurance company has reported that:

> losses in companies without an adequate emergency plan exceed those in companies with good plans by a ratio greater than 15 to 1.

There are plenty of moral, legal and economic reasons why all organizations should have careful plans to deal with emergencies. In emergencies, normal routines and channels of authority and communications may not function properly. In addition, the stress of an emergency situation promotes impaired judgement which can make the situation worse.

Early planning is the only way to prevent an emergency from becoming a disaster.

The objectives of emergency planning are, in order of priority:

1) to prevent death and injury;
2) to reduce damage to buildings, stock and equipment;
3) to accelerate the resumption of normal operations.

Although emergencies, by definition, are sudden unexpected events, past examples teach us that it is possible to anticipate their frequency and severity. Major emergencies are rare events, but when they occur, they are often triggered by minor causes. A small blaze in a garbage bin may develop into a major fire, which, in turn causes explosions leading to extensive structural damage and, perhaps, loss of life.

THE EMERGENCY PLAN

A good emergency plan has six major parts:

1) analysis,
2) procedures,
3) emergency control centre,
4) evacuation,
5) treatment, and
6) exercises or drills.

1) Analysis

The emergency plan comes from a thorough analysis of all potential hazards, both technological and natural. It considers all possible emergencies anticipated, their consequences, and required responses and resources. This includes a detailed list of personnel showing their duties, the resources to be used and the procedure to be followed by each.

Floor plans are developed in the form of large scale maps which show evacuation routes, alternate means of escape, service ducts where water, power and other services are available, areas for treatment of the injured, and safe locations where evacuees can be removed from any danger.

2) Procedures

Since the normal chain of command may not be working, designated persons are given the authority in advance to see that the emergency plan is carried out. The plan ensures that at least one of these persons is on the premises at all times to avoid any lack of authority or confusion about who does what. Decentralization of authority allows the necessary decisions to be made quickly, and this requires that alternates be named for each position of authority. The plan also provides rules for contacting external organizations such as the local fire department, ambulance and/or police, whose assistance may be needed.

3) Emergency Control Centre

Depending on the size of the organization and its layout, it may be advisable to develop an emergency control centre with access to alternate power, telephone, intercom or radio facilities.

4) Evacuation

Because evacuation may become necessary, an evacuation plan is part of the overall emergency

plan. To avoid confusion, only one type of evacuation signal should be used. It should be quite distinct in sound from any other signal used in the plant. The evacuation plan pre-selects primary and alternate evacuation routes. It provides simple ways of making these routes known to all staff, and makes rules for keeping them clear at all times. The evacuation plan identifies safe locations for staff to gather for head counts, to ensure that everyone has left the danger zone. The plan must assign individuals to assist handicapped workers out of danger.

5) Treatment

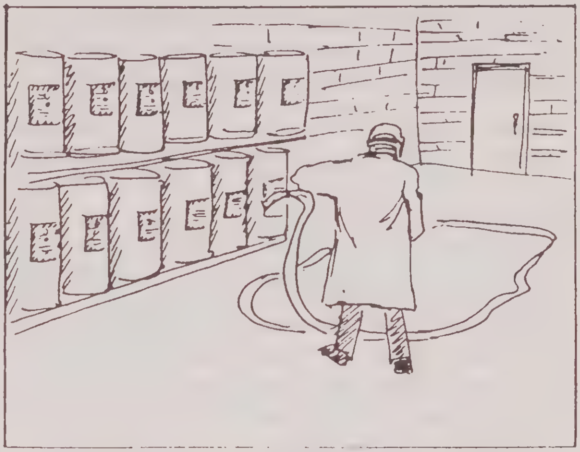
The plan includes procedures for evacuation and treatment of injured persons and the organization of searches for those who may be missing. Alternative sources of medical aid should be provided in case normal medical facilities are in a danger zone.

6) Exercises or Drills

Development of a comprehensive plan is only the first step in readiness for an emergency. Exercises or drills should be conducted on all critical parts of the plan. A thorough review should then be held immediately after each exercise, to identify areas for improvement. Exercises may reveal shortcomings in the plan itself, and these must be changed. Changes in the workplace will also require updating of the emergency plan, and further exercises.

Individuals and teams must be trained so that they can perform as planned during an actual emergency, and such training should include a full-scale exercise to assess proficiency. Drills should be held on a regular basis to keep proficiency high.

Planning and exercises may also bring to light other inefficiencies such as lack of equipment or improper or broken equipment, insufficient supplies, and misunderstandings with external agencies like the fire department or police. All these problems can be rectified before a real emergency occurs. At the same time, it raises safety awareness of the organization and demonstrates its commitment to the safety of the workforce.



AVOIDING AND HANDLING WORKPLACE EMERGENCIES

The most common causes of injury or death in emergencies are:

A) acute over-exposure to a hazardous material, and

B) fire or explosion.

A worker's greatest danger from the above hazards exists when he or she is:

1) working in a confined space, or

2) involved in an accidental spill of a hazardous material.

This section deals first with the hazards of **over-exposure** and **fire or explosion**.

A) Acute Over-Exposure to a Hazardous Material

Acute exposure is one which is intense or severe and which also occurs within a relatively short time span. A worker splashed by a corrosive (destructive) or irritating material has had an acute over-exposure and must act quickly to prevent or lessen injury. The affected area must be flushed with water for at least 15 minutes. This is the most important step, because it dilutes the hazardous material and washes it away.

If the person's clothes have been splashed, they should be removed as soon as possible.

Where the substance has touched the eyes, or in any case where the irritation continues after flushing, obtain first aid help immediately.

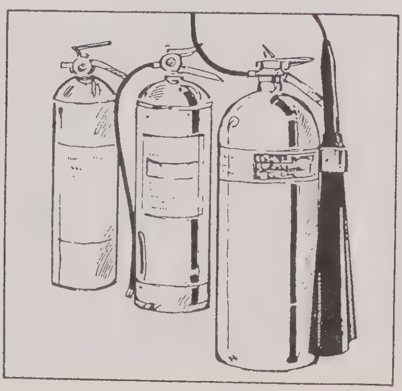
A worker who is unconscious or ill from chemical vapours should be moved into fresh air. If he or she is not breathing, artificial respiration should be initiated immediately and continued until medical personnel arrives. If the victim is unconscious, do not attempt to give food, drink, or medication.

In emergencies, rescuers should wear an appropriate respirator for the hazard (usually a self-contained breathing respirator with a sufficient reserve of air), so that the rescuer does not become another victim.

B) Fire or Explosion

Fires may produce several hazards at the same time. The most obvious hazard from a fire is smoke which contains toxic gases from the decomposition of building contents or structure elements. Smoke not only makes it difficult to see an escape route but it can also cause serious illness. Next to burns, inhalation of smoke is the most common cause of death in fires. The human respiratory tract (lungs and breathing passages) can be injured as well by breathing the over-heated air.

Some chemicals produce very toxic gases as they burn, and these are much more dangerous than the heat, flame or smoke. For example, carbon monoxide gas from burning of hydrocarbons can kill in seconds. Therefore, even very small fires involving chemicals should be treated with great respect.



Fire Prevention: Fire needs fuel, oxygen and ignition to start. It can be prevented by keeping combustible materials (the fuel) away from the air (oxygen) and away from sparks, hot surfaces or open flames (the ignition source). This can be accomplished by:

i) storing and handling combustible materials only in approved fireproof containers;
ii) storing all combustible materials in separate approved areas;
iii) eliminating all ignition sources from areas where combustible materials are stored or used;
iv) cleaning up spills of combustible materials immediately.

In case of fire, the worker who sees it first should sound an alarm and get himself or herself and other workers out of the area. A specially trained fire or emergency team should be called in to put out the fire and clean up. Workers should not attempt to fight fires themselves unless they are trained to do so and have the correct protective and extinguishing equipment.

Working in Confined Spaces

The Occupational Health and Safety Regulation 692 defines confined space as:

> **a space in which, because of its construction, location, contents or work activity therein, the accumulation of a hazardous gas, vapour, dust or fume or the creation of an oxygen deficient atmosphere may occur.**

Under this definition, it is clear that almost any workplace could become a confined space. Some examples of confined spaces are: storage tanks, tank cars and vessels entered through a manhole, tanks, holds of ships, pits, vats, vaults, bins, silos, ducts, sewers, tunnels, the interiors of convertors or of ball or rod mills and pipelines. You may see a clear blue sky overhead, and still be working in a confined space. There are three main reasons why a confined space may become hazardous:

1) toxic substances are present;
2) there is too little oxygen to support life;
3) combustible gases or vapours are present.

Sometimes the dangers are not easily recognized, and this is all the more reason why careful routines should be developed and followed.

Proper entry and exit procedures are necessary and workers must be trained to observe them and to recognize hazards. Following is a basic check list of procedures to be followed before entering and while working in a confined space:

i) inspect work area to spot potential hazards;
ii) fill out an entry permit;
iii) post warning signs at the site to notify others that work is going on in the confined space;
iv) lock out with your own lock and tag all electrical switches and machinery in the confined space;
v) test the air in the confined space for dangerous atmospheric conditions and ventilate if necessary;
vi) among those doing the work, develop a workplan;
vii) choose the proper tools and equipment for working in a confined space (e.g. no leaky welding equipment or worn electric cords);
viii) make sure emergency standby workers have the self- contained breathing apparatus or air-supplied breathing equipment needed to rescue someone from a confined space;
ix) wear proper protective equipment needed for the particular confined space;
x) communicate regularly with observers stationed outside the confined space;
xi) as work goes on, test and monitor continually for development of dangerous atmospheric conditions in the confined space.

These ten procedures are the foundation for an effective confined space health and safety program. No worker should enter a confined space without the proper training.

Coping with Chemical Spills

Chemical spills should be handled by a specially-trained **Emergency Response Team (ERT)**. The workers on this special team should receive special training in the containment, neutralization and cleanup of any hazardous material found at the workplace.

When a chemical spill occurs, all workers should evacuate the area and no one except the ERT should attempt to clean up the spill.

REVIEW QUESTIONNAIRE

Please take a minute and fill out the answers to each of these questions. The answers will be taken up individually in the class.

1. Select the requirements of a good control program.

a. is the cheapest

b. protects exposed workers

c. controls workers' activities

d. adequately controls the hazard

e. screens sensitive workers

f. allows workers to do the job without additional discomfort or distress

g. does not create hazard in surrounding community

2. Select the most effective method of controlling a hazard

a. at the source

b. along the path

c. at the worker

3. Give two examples of control at the source.

1. elimination
2. isolation

4. Give two examples of control along the path.

1. ventilation
2. barriers
3. housekeeping

5. Give two examples of control at the worker.

1. personal protective equip
2. admin control
3. ________

6. What are the first two things you should do in case of an emergency?

1. ________
2. ________

APPENDIX 'A'

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WHMIS

RIGHT TO KNOW

CLASS A

COMPRESSED GAS

September, 1988

MODULE A — PARTICIPANT'S GUIDE

TERMINAL OBJECTIVE:

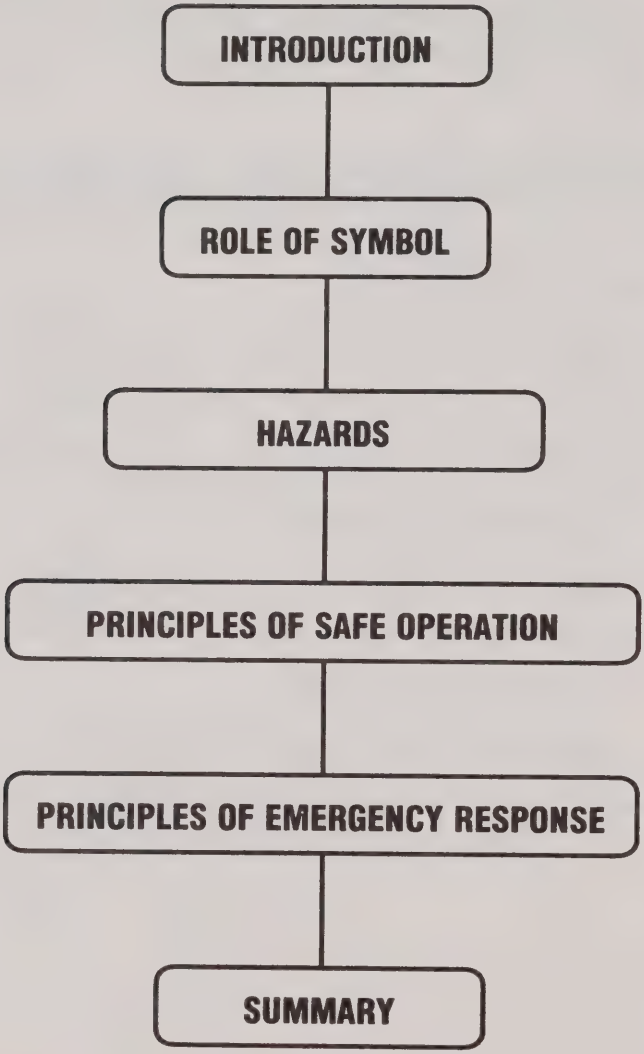
The participants will have a basic knowledge of the hazardous properties of compressed gases so that they will be able to work with them safely.

PERFORMANCE OBJECTIVES:

The participants will:

1. **recognize** the Class A symbol on the label and describe its role;
2. **explain** the hazard properties of compressed gases;
3. **describe** general safe handling, use, storage, and disposal principles of compressed gas;
4. **explain** basic principles of emergency response resulting from a loss of containment (spill or leak).

FLOWCHART


INTRODUCTION
ROLE OF SYMBOL
HAZARDS
PRINCIPLES OF SAFE OPERATION
PRINCIPLES OF EMERGENCY RESPONSE
SUMMARY

Class A - COMPRESSED GAS

Under the Workplace Hazardous Materials Information System, (WHMIS), you have the right to know the hazards of materials you work with, how they can affect your health and how to protect yourself. This guide book will help you to work safely with compressed gas. It provides the basic resource material to be used during the training program and it can be used as a handy reference guide after the program.

Five main subject areas are covered:

1. What is a compressed gas?
2. The hazard symbol for compressed gas.
3. The hazards presented by compressed gases.
4. Controlling Exposure — Principles for working safely with compressed gas.
5. What to do in an emergency involving a compressed gas.

This booklet cannot cover every possible situation. You should know what the symbol on the label means; understand what is on the Material Safety Data Sheet (MSDS), and know how to apply that information when working with compressed gases.

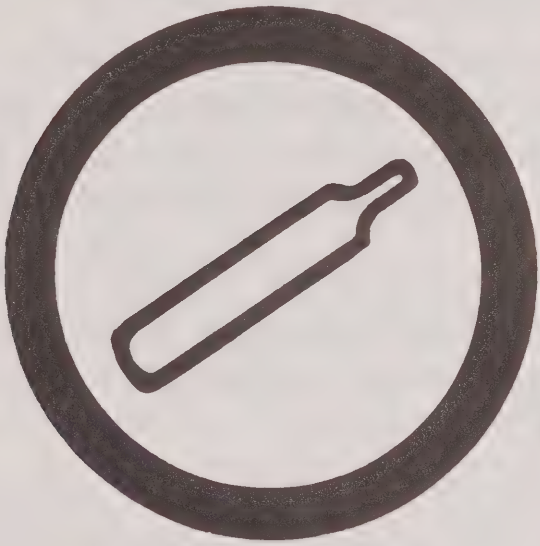
1. What is a compressed gas?

Any product, material or substance contained under pressure greater than atmospheric pressure is a compressed gas. This includes gases liquefied by compression or refrigeration.

Compressed gases are present in research and industrial operations and in our daily lives. Many workplaces use compressed gases in welding, brazing, cutting, for fast refrigeration in food preserving, and for use in analytical laboratories. Many homes are heated by liquefied compressed fuels such as propane and butane. Many use cylinders of compressed propane to fuel barbecue grills. Compressed oxygen and breathing air are common sights in health care and first aid facilities.

2. The hazard symbol for compressed gas.

The hazard symbol is a picture of a cylinder, representing a container of compressed gas, enclosed by a circle:



In some areas, you may see this symbol together with one or more other hazard symbols. For example, the compressed gas inside the cylinder may be toxic or hazardous in other ways. You should refer to the other guides in this series for further information concerning their hazards.

3. Hazards presented by compressed gases.

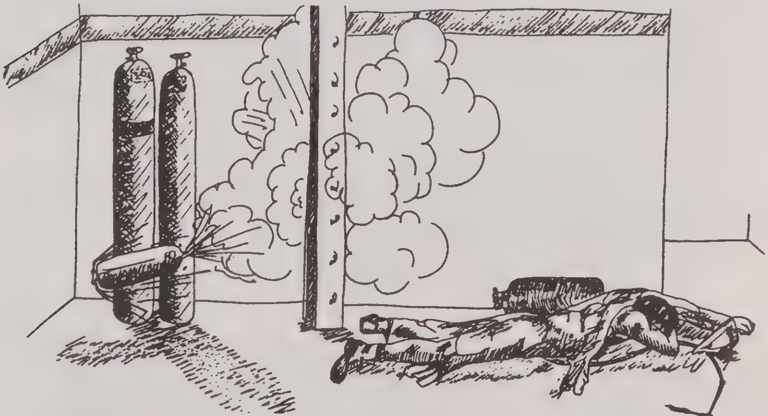
All compressed gases are hazardous because they are under high pressure (See example A below), and some may also be hazardous because they

- are flammable and may explode; Acetylene, hydrogen, propane, ethylene oxide are gases of this type. (See the guide for Class B Flammable Materials).
- are toxic (poisonous). These include phosgene, carbon monoxide, and hydrogen fluoride. (See the guide for Class D.)
- cause frostbite on contact. Cryogenic gases such as carbon dioxide, liquid oxygen, liquid petroleum gases fall in this category.
- are corrosive, meaning that they destroy the skin and other body tissues on contact. Ammonia, chlorine and fluorine are corrosive gases. (See the guide for Class E.)
- cause skin irritation in the form of a rash or sores. Ammonia and chlorine are irritant gases.

- are highly reactive to heat, flame, water or other substances and may cause a fire or explosion or the release of toxic gases when they react to these other substances. Bromine and chlorine are reactive gases. (See the guide for Class F.)
- are oxidizers, they contain oxygen and may therefore help other materials to catch fire. Nitrous oxide, liquid oxygen and fluorine are oxidizers. (See the guide for Class C.)
- are hazardous because they are commonly used in confined spaces. (See Section 71-75 of Regulation 692 under the Ontario Occupational Health and Safety Act and see example B on page 8.)

Hazard Examples

A. An example of a high pressure hazard is when the cylinder valve has been sheared. This may be due to a defect in the valve system, or in the cylinder itself, or from a collision with another object. The released compressed gases expand rapidly causing the cylinder to take off like a rocket unless it is firmly secured. A leak in the cylinder, or in the valve system, or in the hoses, will allow gas to escape and create a hazard.



B. An actual case of a confined space hazard from compressed oxygen is this one involving seam-welding containers. During the assembly procedure, a small section of a seam was mis-welded. The worker attempting to repair the seam climbed

into the tank. After a few seconds inside, the tank became hot and smoky. Oxygen from the torch was used to ventilate the space and because of the oxygen-enriched atmosphere, the oxygen reacted with the oil and grease stains on the clothes.

C. Asphyxiant gases (including argon, helium, nitrogen, carbon dioxide, carbon monoxide) displace the oxygen either in the air or in the body. An example of an asphyxiant hazard from compressed gas took place in a newly constructed container to hold hydrogen gas. An inspector wished to test the structural soundness of the vessel, but couldn't do so because the vessel was filled with hydrogen which is very

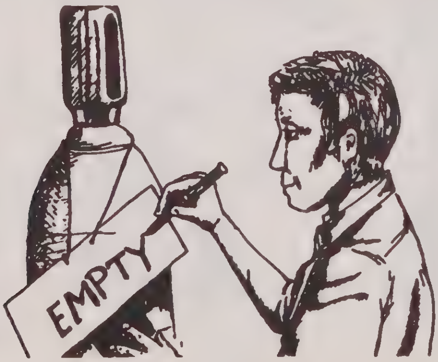
flammable and might explode during testing. The vessel was filled with a non-explosive gas, carbon dioxide (CO_2) to push out the hydrogen gas. Since CO_2 is heavier than air, the top lid and the bottom drain were left open to let the vessel breath naturally. However, the airflow in the plant that day carried the CO_2 to a nearby work station. Because CO_2 is an asphyxiant, some workers collapsed due to oxygen deficiency.

4. Principles of handling and storing compressed gas.

a) Handling and Storage

- **Follow** your company's safe handling and storage procedure.
- **Read** all the information on the label and the MSDS for that particular gas, before handling it.

- **Check** with your supervisor before handling any new compressed gas.
- **Inspect** the cylinder and valve system for damage, leaks and wear, and the last pressure test date.
- **Move** cylinders using a cylinder carrier designed for that purpose with cylinder caps in place.
- **Store** all cylinders in a cool, dry, well ventilated and fire resistant area and away from sources of ignition and excessive heat (51.5 degrees Celsius is the maximum), with all safety devices attached.
- **Store** cylinders of different gases in separate areas (flammable, corrosive, reactive, and fuel gases should be separated from each other).
- **Store** full and empty cylinders in separate areas, and label empty



cylinders (because if an empty cylinder is attached to a pressurized system, backflow of a foreign material into that cylinder may occur).

- **Secure** all cylinders, so that they will not become dangerous projectiles if a leak develops.
- **Use** the proper gas handling equipment (stated in the safe handling procedure used in your workplace).
- **Use** the personal protective equipment specified in your safe handling procedure.

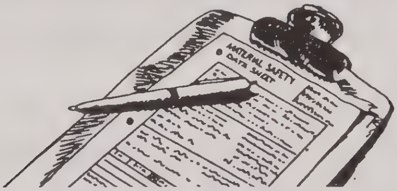
b) Use

- Always **read** and **understand** your safe operating procedure before using any compressed gas.

- **Know** the gas you will be handling.
- **Crack** open the valve slowly by hand.
- **Close** main cylinder valve when not in use.
- **Close** regulator outlet needle valve if one is supplied. Do not rely on the cylinder valve.
- Cylinders with corrosive gases should have a **maximum turnover time** of three months.
- **Never use** a gas in an area where there is insufficient ventilation.
- **Always use** compressed gases properly. Blowing dirt off your clothing with compressed gas may create an extreme health hazard whether by spreading toxic materials into the air, or by injecting air or gas bubbles into your blood where they may work themselves into your heart and cause blockages.
- **Keep** cylinders in a remote outside storage area, and use a manifold to pipe low-pressure gas into buildings, where possible.
- **Use** the smallest practical size of cylinder.

c) Disposal of Leaking Cylinders

Isolate the cylinder in a vented or open area, and contact your supervisor to learn the correct disposal procedure.



5. What to do in an emergency involving compressed gas.

- **Follow** your company's emergency response procedures.
- **Refer** to the MSDS for the specific gas you are using.
- **Report** any leaks to your supervisor.
- **Contain** or safely dispose of a leaking product if possible.
- In case of fire, **move** cylinders safely away from the fire area if possible.
- **Use** the personal protective equipment specified in the safe operating procedure for your workplace.

CASE STUDY

The anchoring of compressed gas cylinders, to keep them from being knocked over and possibly breaking off a valve is a legal requirement. What would really happen if a cylinder valve were knocked off? The following is an example of what did happen in **The Case of the Runaway Cylinder**.

Six 220 cubic-foot cylinders of compressed carbon dioxide (CO_2), part of a fire extinguishing system, had been moved away from their wall supports to allow painters to complete painting the area. While moving them back into position, it was noticed that one of the cylinders was leaking. A painter had the cylinder leaning against his shoulder, and was attempting to scoot it across the floor. At this moment the valve separated from the cylinder head and was projected backward hitting the side of a steel cabinet.

The man suddenly found himself with a jet-propelled 100 kilogram piece of steel. He wrestled it to the floor, but was not able to hold it. The cylinder scooted

across the floor hitting another cylinder, knocking it over and bending its valve. The cylinder then turned 90 degrees to the right and travelled six metres where it struck a painter's scaffold causing a painter to fall two metres to the floor. After spinning around several times, it travelled back to its starting point where it struck a wall.

At this point the cylinder turned 90 degrees to the left and took off lengthwise across the room, chasing an electrician in front of it. It crashed into the end wall 12 metres away breaking loose four concrete blocks. It turned again 90 degrees to the right and scooted through an open door, still chasing the electrician. The electrician ducked through the next open door, but the cylinder continued its travel in a straight line for another 18 metres, where it fell from a dock into a truck-well area. The rest of the cylinder pressure was released as the cylinder spun harmlessly around the truck-well area. The painter who fell from the scaffold received multiple fractures of his leg.

This cylinder contained pressure of about 6,200 kilopascals, but many cylinders are pressurized to 15,170 kilopascals.

QUESTIONS ABOUT THIS INCIDENT:

1. List three (3) reasons why this incident happened.

   (a) ______________________________

   (b) ______________________________

   (c) ______________________________

2. What hazards were involved with the gas that was leaking out of the cylinder? Explain.

   (a) ______________________________

   (b) ______________________________

   (c) ______________________________

3. List three (3) ways of preventing this situation from happening again.

   (a) ______________________________

   (b) ______________________________

   (c) ______________________________

APPENDIX 'A'

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WHMIS

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CLASS B

FLAMMABLE and COMBUSTIBLE MATERIAL

September, 1988

MODULE B — PARTICIPANT'S GUIDE

TERMINAL OBJECTIVE:

The participants will know the hazards and health effects of flammable and combustible materials, be able to work safely with these materials and protect themselves under normal and emergency conditions.

PERFORMANCE OBJECTIVES:

The participant will:

1. **explain** the role and purpose of the label;
2. **recognize** the hazards of flammable and combustible materials;
3. **explain** how exposure to flammable and combustible materials may occur and the health effects of exposure;
4. **describe** some procedures for safe handling, storage and disposal;
5. **understand** what to do in an emergency situation.

FLOWCHART

INTRODUCTION	Overview of WHMIS Class Module Objectives
CLASS B	Definition Hazard Symbol Role of label Examples
HAZARDS	Health Fire and explosion Chemical reactivity
PROPERTIES	Flash point Flammable limits Auto-ignition Conditions of flammability Means of extinction Hazardous combustion products
HEALTH EFFECTS	Inhalation Skin contact/absorption Ingestion
VIDEO	Overview of Class B — properties, health effects — safe use, emergency response
SAFE USE	Procedures/Practices — handling — use — storage — disposal
EMERGENCY RESPONSE	— Procedure for handling — training and preparation
SUMMARY	

INTRODUCTION

Under the Workplace Hazardous Materials Information System, (WHMIS), you have the right to know the hazards of materials you work with, how they can affect your health and how to protect yourself. This guide will help you to work safely with flammable and combustible material.

It provides the basic resource material to be used during the training program and it can be used as a handy reference guide after the training program.

This guide will cover six main subject areas:

1. What are flammable and combustible materials and where are they used?
2. The hazard symbol for these materials.
3. The properties and hazards of flammable and combustible materials.
4. Health effects.
5. Principles for working safely with flammable and combustible materials.
6. Emergency procedures.

1. What are flammable and combustible materials?

Flammable means the ability to ignite and burn readily. A flammable liquid gives off a vapour which can be readily ignited at normal working temperature if there is a source of ignition. Under the **Controlled Products Act** a flammable liquid is one which ignites below 37.8°C (100°F).

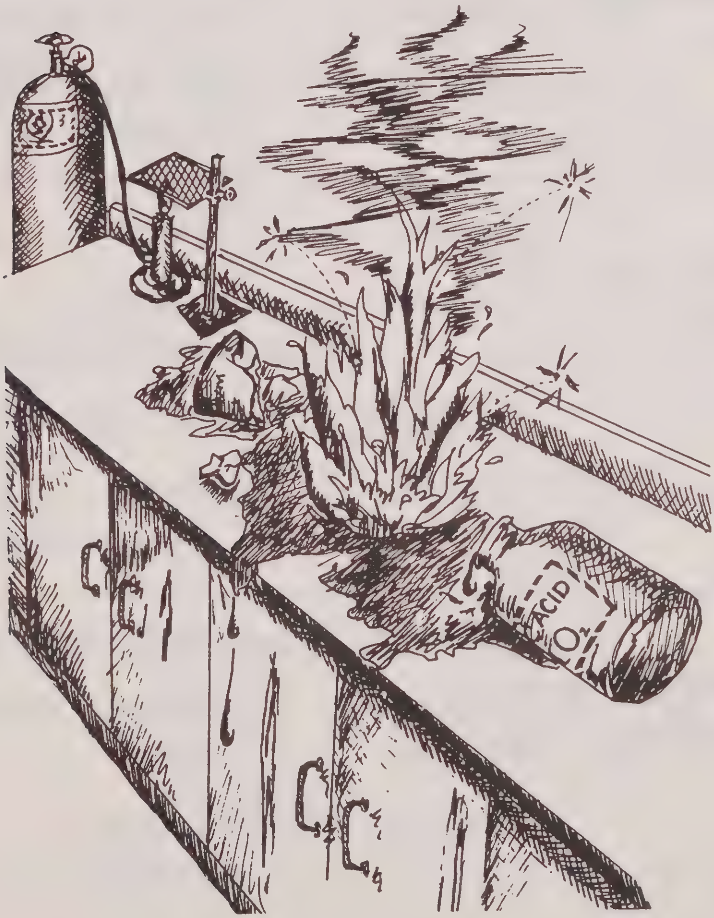
Combustible means the ability to burn. A combustible liquid will burn if it is between 37.8°C (100°F) and 93.3°C (200°F). This range of temperature is well above normal room temperature.

The terms combustible and flammable both describe the ability of a material to burn. Generally, combustible materials are less easily ignited than flammable materials.

REACTIVE FLAMMABLE MATERIAL

A reactive flammable material is a substance which:

- spontaneously becomes combustible when it reacts with air or water;
- or reacts vigorously with air or water without actually catching fire and gives off flammable gas.



There are six divisions of flammable and combustible materials. Below is a list of examples of each division.

FLAMMABLE AND COMBUSTIBLE MATERIALS

DIVISION	EXAMPLE	USES
1. Flammable Gas	propane	fuel
	butane	fuel
	acetylene	fuel for welding operations
2. Flammable Liquid	ethanol	solvent
	acetone	solvent, degreasing agent
	turpentine	paint, solvent
	toluene	solvent, degreasing agent
3. Combustible Liquid	kerosene	fuel for heating
	Stoddard solvent	degreasing agent, solvent
	pine oil	furniture finishings

FLAMMABLE AND COMBUSTIBLE MATERIALS (cont'd)

DIVISION	EXAMPLE	USES
4. Flammable Solid	carbon black	used in dye and pigment manufacturing
	charcoal	fuel for heating
5. Flammable Aerosol	spray paints	painting, e.g. automobiles
	oil sprays	lubricant for mechanical parts
	varnish	protective coating
6. Reactive flammable material	acetylene	welding torch fuel
	ammonia	refrigeration units, e.g. freezer
	chlorine	chemical manufacturing, water treatment
	propane	fuel

2. The hazard symbol for flammable and combustible material.

You can identify these materials by the hazard symbol on the label. The hazard symbol is specific for each class of hazardous material. The symbol warns you immediately of the possible hazard of the material.

The label also provides you with information such as the name of the product, some basic precautions and the hazard symbol. The label must also refer to the Material Safety Data Sheet (MSDS) which provides more information on the product.

3. The properties and hazards of flammable and combustible material.

Flash Point
This is the lowest temperature at which a liquid or solid gives off enough vapour to form an air vapour mixture that will burn if it makes contact with an open flame or spark.

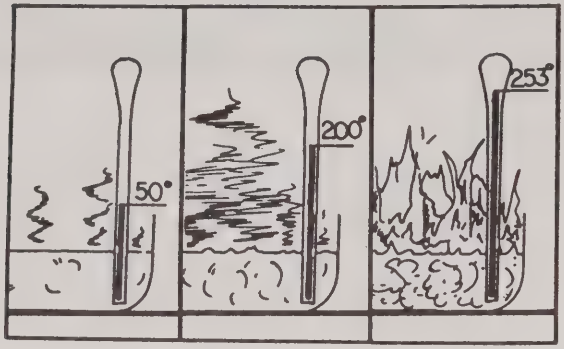
The lower the flash point of a liquid, the higher the risk of fire.

For example, turpentine has a flash point of 35°C. If the temperature of the process in which it is used or the room where it is stored reaches 35°C, then a fire may result if its vapours come in contact with an open flame or spark.

Auto-Ignition Temperature
This is the lowest temperature at which spontaneous ignition of the material in air begins without any flame or spark. The closer the auto-ignition temperature is to room temperature, the greater the risk of fire.

For example, turpentine has an auto-ignition temperature of 253°C. It will

therefore not ignite by itself unless its temperature reaches this point.



Flammable Limits

Flammable and combustible material may also explode if the vapour or gas mixes with air in the presence of a flame, spark or a charge of static electricity. Some of these materials can also explode if exposed to heat, friction or if they react with other chemicals.

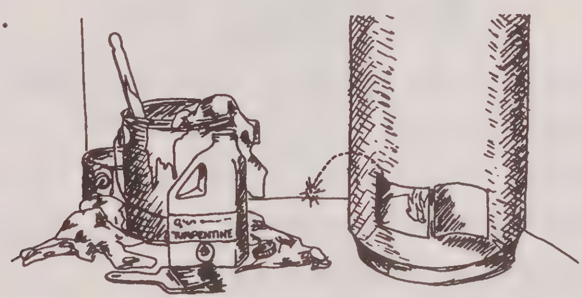
The MSDS indicates how concentrated the vapour or gas must be in the air before an explosion may occur. This is called the **flammable limit**. Flammable limits are given as a percent, by volume of the material in air and a range is usually given.

The **lower flammable limit (LFL)** is the lowest concentration of gas or vapour which will burn or explode if ignited.

The **upper flammable limit (UFL)** is the highest concentration of gas or vapour which will burn or explode if ignited.

Below the LFL, the mixture is too lean to burn. Above the UFL the mixture is too rich to burn. However, concentrations above the UFL are still dangerous because if the concentration is lowered (by introducing fresh air), the mixture could enter the flammable range.

For example, ethylene has a lower flammable limit of 2.7%. In the presence of a source of ignition, when the concentration is below 2.7% there is no risk of explosion. But when it reaches the 2.7%, the mixture is in danger of exploding.



Static Electricity is generated by the contact and separation of unlike material. The principal hazards of static electricity are fire and explosion caused by spark discharges containing enough

energy to ignite flammable or explosive vapour, gases or dust particles.

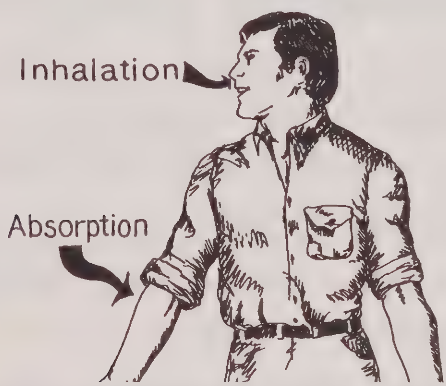
The control of static electricity is done primarily by **bonding** and **grounding**. Bonding is done to eliminate a difference in static potential between objects with metallic connectors such as filling a small container with a flammable liquid from a larger container. The purpose of grounding is to eliminate a difference in static charge production

between an object and the ground. An example would be grounding a large 45 gallon drum of a flammable material with metallic connectors between the container and the ground.

The Material Safety Data Sheet (MSDS) provides you with more details on the explosive hazards of specific Class B materials. Always check the MSDS to learn more about the material you are handling.

4. Health effects of exposure.

The main hazards of Class B materials are due to the fire, explosion and reactivity properties of these materials. Moreover, because these materials often give off vapours, you could breathe in the vapours. This can cause respiratory irritation, narcosis, damage to the central nervous system or systemic poisoning to the liver or kidney. Some Class B materials can also pass directly through the skin into your body and many cause skin irritation and inflammation.



Be sure to check the MSDS to learn what specific health hazards may result from exposure to material you are handling. If you do not understand the information, ask your Supervisor or your Joint Health and Safety Representative for assistance.

5. Principles for working safely with flammable and combustible materials.

* Read the label, know the hazard symbol.
* Be aware of the hazards from fire, explosion and to your health - check the MSDS.
* Avoid all ignition sources - sparks, smoking, flames and hot sources.
* Use, handle and store in well-ventilated areas only.
* Use approved equipment - safety cans, fire extinguisher, bonding wire, flammable materials storage cabinets, etc.
* Ensure proper bonding and grounding of containers when pouring liquids to prevent electric sparks.
* Practise good housekeeping. Keep containers closed when not in use to reduce exposure.
* Know how to handle emergency situations, e.g. leak, spill, fire.
* Dispose of all waste material, e.g. liquids, rags, in proper containers.

* Keep reactive flammable material dry and isolated from oxygen (in air) or other **oxidizing agents** (refer to Class C materials). They should be stored and handled in an atmosphere of unreactive gas, such as nitrogen or argon.
* Wear and use the personal protective equipment and clothing for the job, e.g., gloves, face shields, respirators, etc.
* Follow the health and safety rules or procedures for your job.

6. Emergency procedures

In general, when an emergency or accident occurs you should:

* Report all emergency situations immediately;
* Seek first aid;
* Leave clean-up to trained personnel;
* Use appropriate personal protective material during the emergency;
* Leave the area if necessary.

SUMMARY

In this module on Class B - Flammable and Combustible Material, we have covered:

- What flammable and combustible materials are,
- How to recognize them,
- The properties that make Class B materials hazardous,
- The health effects of exposure,
- Procedures for safe handling and use, and
- Emergency procedures.

By being informed of the hazards, knowing the safe work procedures, and any emergency responses, you can protect yourself. When in doubt, get help from your Supervisor or Health and Safety Representative. You **can** work safely to prevent injury and accident to yourself and your co-workers.

Be an informed worker - "Use Your Right to Know".

Review Questionnaire

1. The flash point of **acetic anhydride** is **39.5**°C (129°F) and the flash point of **ethyl alcohol** is **12.7**°C (55°F).

Which one is flammable?

____

2. The auto-ignition temperature of **Acetone** is -17.8°C (0°F) and the auto-ignition temperature for **toluene** is 4.4°C (40°F).

Which one will burn by itself *first*?

____

3. Which of the following properties are true (T) or false (F)?

(a) Flammable and combustible material will not burn. T F

(b) The flash point (°C) indicates the risk of fire. T F

(c) Sparks, open flames and smoking should not be allowed near flammable materials. T F

(d) The flammable limits indicate the range of concentration in air which will burn or explode. T F

4. Which symbol stands for WHMIS flammable and combustible material?

a.

c.

e.

b.

d.

5. Exposure to some Class B materials may affect your health. T F

6. Indicate which are safe working procedures for Class B materials:

(a) Use, handle and store in well ventilated areas only. T F

(b) Read the label, know the hazard symbol. T F

(c) Safety cans do not have to be used. T F

(d) Follow the health and safety rules for your job. T F

7. Name two (2) steps you would take in an emergency situation.

(a) ________________________________

(b) ________________________________

8. What would you do if you do not understand the information on the label or MSDS?

CASE STUDY

An operator was engaged in mixing ink for a printing operation.

Solvent was needed to thin the ink, so the worker drew some solvent from a dispensing drum into an open gallon can. While filling the can, a spark occurred and the solvent caught fire.

Although fire extinguishers were nearby, the worker picked up the burning can and tried to carry it out of the building.

The worker tripped on his way out and suffered severe burns.

CASE STUDY — PARTICIPANT'S QUESTIONS

1. What caused the accident?

2. How could this accident have been prevented?

3. What would you have done when the fire started?

APPENDIX 'A'

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WHMIS
RIGHT TO KNOW

CLASS C
OXIDIZING MATERIAL

September, 1988

MODULE C — PARTICIPANT'S GUIDE

TERMINAL OBJECTIVE:

At the end of the training session, the participants will have some knowledge and understanding of the hazards, basic properties and adverse health effects of oxidizers so they can work safely with these materials and reduce the number of accidents and illnesses related to exposure.

PERFORMANCE OBJECTIVES:

The participants will be able to:

1. **clarify** purpose of session, and to **recognize** class symbol;
2. **define** what oxidizing substances are, and provide examples;
3. **discuss** where oxidizing materials can be found;
4. **identify** the hazards involved with oxidizing materials;
5. **describe** how an exposure can occur;
6. **describe** how adverse health effects can occur from an exposure.

FLOWCHART

CLASS C - OXIDIZERS

INTRODUCTION	—Brief overview of WHMIS Hazard Classifications —Class C - Oxidizers
GENERAL INFORMATION	— basic properties — where found — examples of oxidizing materials
HAZARDS INVOLVED	— fire and explosion potential — how an exposure can occur
HEALTH EFFECTS	Mode of entry into the body — acute toxic effects — chronic toxic effects
SELF-PROTECTION	— handling, use, storage, disposal, and emergency response measures — protective equipment
FURTHER SOURCES OF INFORMATION	— texts, journals, bulletins — safety organizations — government

OXIDIZERS

Under the Workplace Hazardous Materials Information System, WHMIS, you have the right to know the hazards of materials you work with, how they can affect your health and how to protect yourself. This guide book will help you to work safely with oxidizers. It provides the basic resource material to be used during the training program and it can be used as a handy reference guide after the program.

Five main subject areas are covered:

1. What are oxidizers?
2. How can you be exposed?
3. What are the health effects?
4. Controlling exposure - Procedures for working safely with oxidizers.
5. What to do in emergencies involving oxidizers.

1. **What are they?**

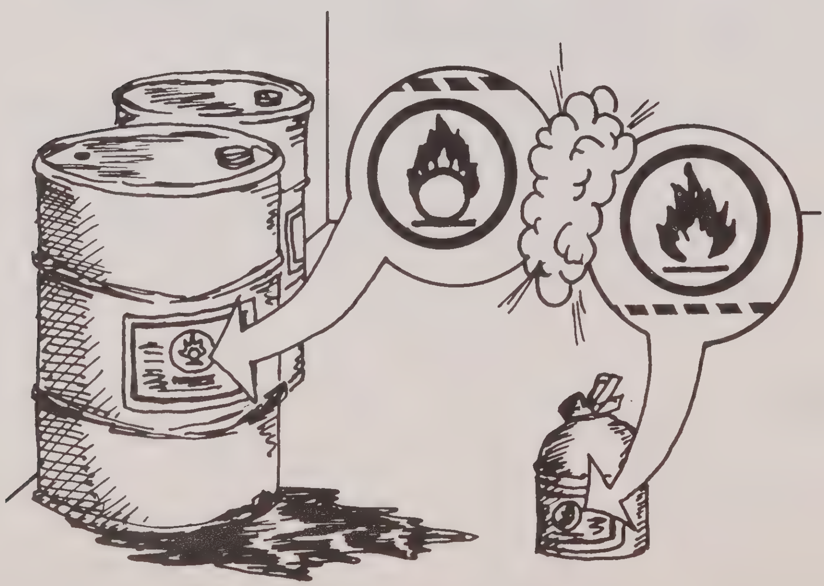
Oxidizers are chemicals which cause other materials to catch fire by supplying oxygen. Oxidizers are not combustible (inflammable) themselves, but they cause or contribute to the combustion of other materials by giving up oxygen or another oxidizing material.

They may be present in the following states:

(a) neutral (ozone, lead oxide, nitrotoluene)

(b) alkaline (potassium permanganate, oxygen)

(c) acidic (chromic, nitric, and other acids)



Oxidizers can be found in the form of gas, (oxygen, ozone, fluorine), liquid (nitric and chromic acid, sodium hypochlorite) and solid (potassium permanganate, chromates, dichromates).

Some oxidizers, like ozone, chlorine and fluorine, have a strong odour. Others, like oxygen, hydrogen and peroxides, are odourless. This makes them particularly dangerous because they are not detectable even at high concentrations.

Oxidizing materials such as chlorine dioxide, chlorates, perchlorates, permanganates, chromic acid and peroxides are capable of strong reactions, which can result in an explosion.

Where are they?

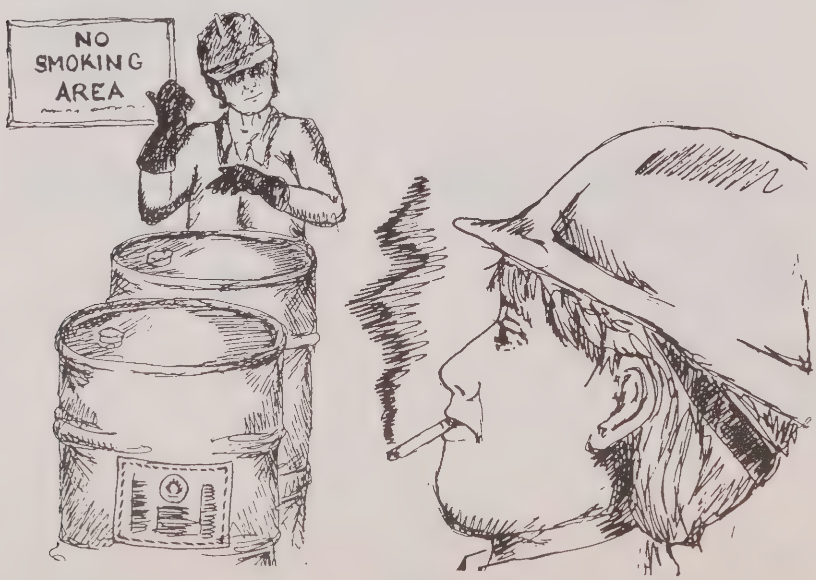
There is **widespread use** of oxidizing materials **in industry.** For example, in chemical and electrochemical production, oxidation is used to obtain sulphuric acid from sulphur and sulphates. Ammonia is generated from the oxidation of nitric acid, benzoic, maleic and phthalic acids from aromatic hydrocarbons; and cyclohexanone and phenol from toluene. Electrolytic oxidation is used in the production of inorganic substances, chromates, permanganates, persalts and hydrogen peroxide. Oxidation is the basis in which pharmaceutical preparations, protective oxide coatings on metal surfaces, photographic processes and methods of chemical analyses in the laboratory are obtained.

Listed below are a few examples of oxidizing materials and the products or process they are associated with:

Oxidizers	Product or Process
• **Organic peroxides**	-in manufacturing of plastics, resins, synthetic finishes
MEK peroxide	-as a curing agent
dibenzoyl peroxide	-as a bleaching agent for flour, curing agent
hydrogen peroxide	-bleaching agent, disinfectant, in laboratories, for testing purposes
• **Chlorates, perchlorates**	-in manufacturing of chlorine dioxide, weed killers, dyes, matches, fireworks, photographic processes
• **Nitric acid, chloric acid and concentrated hydrogen peroxide**	- as a liquid propellant (rocket launch industry)

2. How can you be exposed?

Exposure is generally the result of an accident such as a **leak, spill or lack of containment.** Oxidizers are not combustible themselves but when they come into contact with combustible materials they can cause fires and explosions. Some oxidizers, peroxides, for example, are very sensitive to **shock** and **sudden impact** which cause them to release sudden energy in the form of high temperatures. This may lead to an explosion. Oxidizers can also **cause pipes and seals to corrode** which may lead to toxic substances leaking into the workplace. **Smoking** in your work area could also cause a fire or explosion and should be avoided.



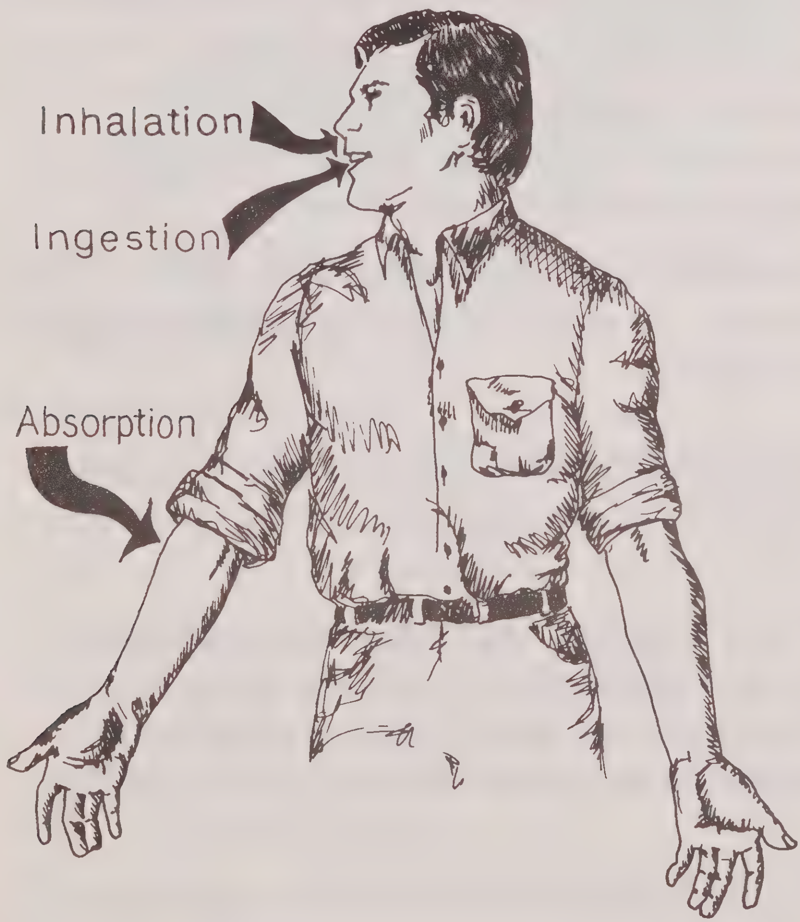
3. What are the health effects?

Oxidizing materials may enter the human body in the following ways:

(a) the skin

(b) the respiratory system (inhalation)

(c) the gastrointestinal tract (ingestion)



Some of the health effects and symptoms of exposure to oxidizers are:

Skin Contact:
skin irritation, sensitization of the skin, eczema or dermatitis.

Eyes:
burns to the mucous membranes, blindness in severe cases.

Respiratory:
burns to the mucous membranes, nausea, headaches, coughing and sneezing, inebriation, death through asphyxiation in severe cases.

Gastrointestinal tract:
nausea, death if ingested in sufficient amounts.

Long term body effects may include blood and nervous system changes, and liver and kidney diseases.

If any worker feels that he may have been exposed to oxidizing materials, this should be reported to the worker's own doctor or to the health unit in the plant.

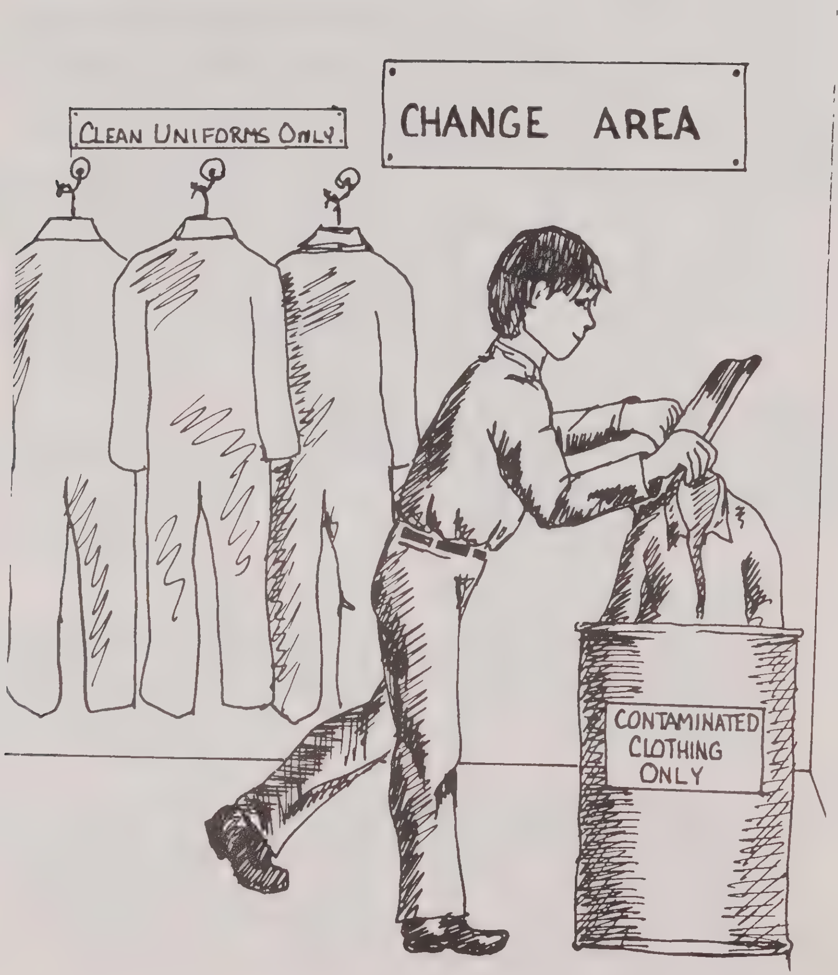
4. How can you protect yourself? SELF-PROTECTION

Protecting yourself means **being aware** of the hazards, **wearing** protective clothing, and **being knowledgeable** about the procedures for handling, use, storage and disposal. It also means **knowing what to do** in an emergency situation. Some of the important points to remember regarding the use, handling, storage and disposal of oxidizers include the following:

USE AND HANDLING PROCEDURES

- **Only use** materials which come labelled; read the label and the MSDS and follow the manufacturer's instructions.
- **Know** the materials which are incompatible (may interfere with one another, chemically) if they are mixed, as they could cause a fire or explosion. Ask if you are unsure.
- **Only those who are trained** should mix and dispense oxidizers.

- **Do not allow spills** to occur, particularly on your skin. If your clothing is contaminated with chemicals, rinse it at work - do not take it home.

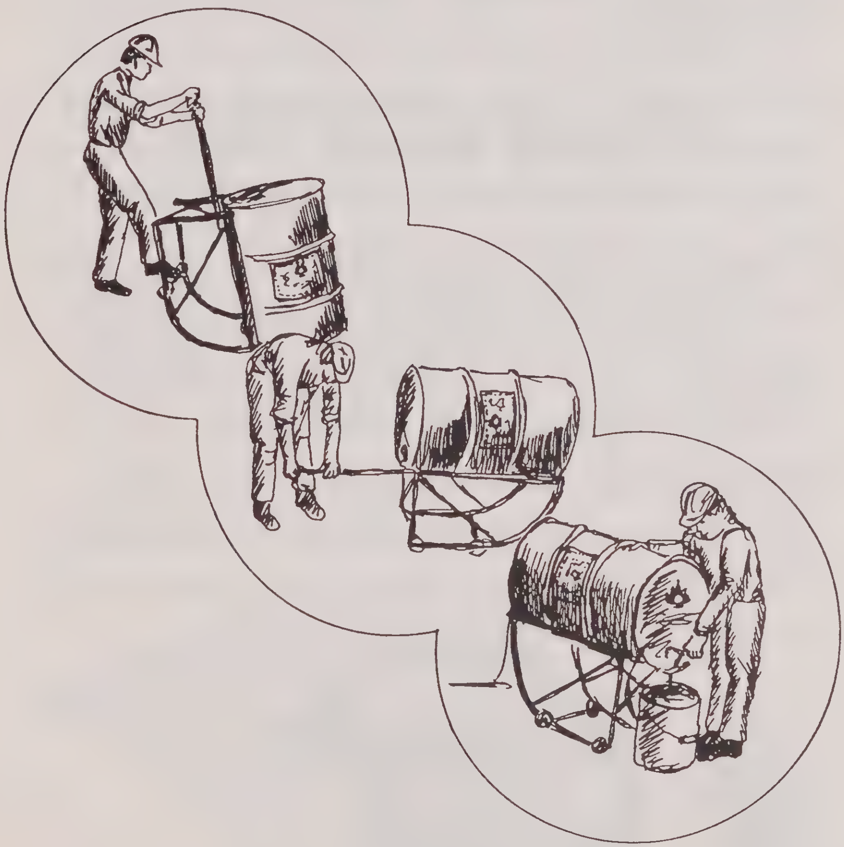


- **Use** oxidizers only in appropriate temperatures, as high temperatures cause these substances to react.
- **Use only** chemicals in the quantities you need, decant oxidizers into appropriate containers.
- **Wear** protective clothing such as flame-proof and non-absorbent work wear, plastic apron, goggles and respirator.
- **Do not smoke** in your work area; report any source of ignition or leakage in piping system or tanks.
- If you work in a laboratory, **use glass or earthenware containers,** and discard any old lab samples; use only clean equipment and only stock what is needed.

STORAGE PROCEDURES

- **Store** in cool, dry, ventilated area which is explosion-vented and steel constructed.
- **Storage areas** should have sprinklers and fire extinguishers.
- All containers and drums should be **labelled,** and an MSDS should be readily available for each product in storage.
- **Maintain** good housekeeping and do not stack drums.
- **Do not store** oxidizers near incompatible mixtures such as acids and combustible materials (i.e. sodium chlorite forms an explosive mixture when combined with combustible materials and releases chlorine dioxide gas when it comes in contact with strong acid solutions).
- **Do not store** oxidizers near reducing agents such as cobalt, naphthanate, tertiary amines and mercaptans. Oxidizing agents such as concentrated mineral acids should never be stored near organic peroxides.

- **Do not store** near radiators, steam pipes, direct sunlight, or electrical wiring.
- When oxidizers are transported from the storage to the worker area, they should be in **tightly closed vessels,** pneumatic conveyors or systems.



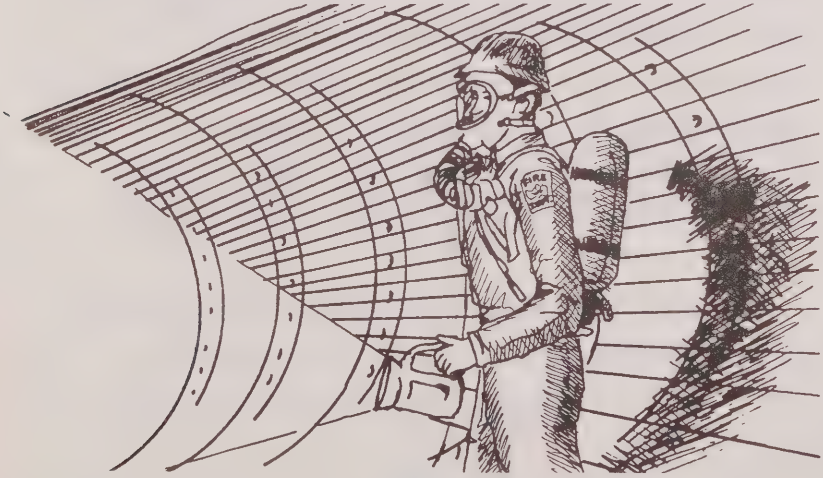
DISPOSAL PROCEDURES

1. **Refer** to established procedures in your workplace.
2. Oxidizers **should be disposed of by trained personnel.** Following are some useful hints for disposal.

- **Exercise caution** when disposing of containers.
- Non-combustible **containers should be thoroughly washed,** whether they are to be discarded or reused.
- **Send** all waste and spilled or outdated peroxide to an approved disposal site. Do not dump it into the sewer which may cause a distant explosion.
- **Sweep up** with non-sparking tools. Use clean white rags because coloured rags contain dyes which can react with oxidizers.

WHAT TO DO IN AN EMERGENCY

1. **Follow** your company's emergency procedures.
2. **Alert** fellow workers.
3. **Evacuate** the area immediately; protect your eyes, lungs and skin, and alert fire department and ambulance.
4. **Alert** supervisor if at all possible.
5. **Only those** who have received proper training (emergency response team, fire department) are prepared to handle emergency situations which include spills, fire and explosion. These people must have **protective equipment** which includes self-contained, positive pressure, breathing apparatus.



6. **Keep** unnecessary people away and isolate hazardous area.
7. **Never touch** spilled material; remove combustibles (wood, paper, oil) away from spilled area.

First Aid

For ingestion
- induce vomiting (unless oxidizing agent is also corrosive), obtain medical attention.

For skin or eye contact
- flush with water for at least 15 minutes, obtain medical attention.

For inhalation
- move victim to fresh air, call an ambulance, keep patient warm. If the victim is injured, he or she should only be moved by trained personnel. If victim is not breathing, start emergency resuscitation procedures (mouth to mouth breathing with mouth guard) and if qualified to do so, start CPR.

Review Questionnaire

Please select the most appropriate/ correct response.

1. How do oxidizing agents such as peroxides, chromic acid and sodium hypochlorite enter the body?

   (a) through the skin only

   (b) through the skin, lungs and gastrointestinal tract

   (c) through the blood, by blood transfusion

2. How could a worker be potentially exposed to oxidizers and not be aware of it?

   (a) by working adjacent to a leaky pipe which has been corroded, and which contains an oxidizing substance

   (b) by working in an area where there are high concentrations of ozone, fluorine or oxygen

   (c) by keeping hydrogen peroxide solutions for too many years and then using them again

3. If any oxidizing substances splash onto the skin, or eyes, any further injury may be avoided by:
   (a) applying burn ointment to the skin, eye ointment to eyes, getting patient to a doctor
   (b) washing the skin/eyes for 15 mins. at least, with copious amounts of water, to reduce local corrosive effect, and getting the patient to a doctor
   (c) calling a doctor, placing cool compresses on skin, flushing eyes with water, keeping patient warm until help arrives

4. To protect the worker's health and safety; the worker needs to know that:
   (a) oxidizing substances, when inhaled in a mist or dust, can cause irritation to the upper respiratory tract and mucous membranes of the eyes
   (b) some oxidizers which have no odour can cause the worker to be exposed without his knowledge
   (c) the long term physiological (body) effects are still not fully understood and therefore these chemicals must be handled with care

CASE STUDY

In a laboratory, an operator was using "bottle acid", (which is potassium dichromate and concentrated sulphuric acid) and acetone (separately), in cleaning syringes. Upon completion, the beaker of bottle acid was poured off and placed into the sink. Acetone was then used to clean a brush. Some of the acetone splashed into the unrinsed beaker which had contained the bottle acid. The acetone ignited. As the operator jumped back, he tipped over the flaming beaker of acetone into a small tray covered with blotter paper. The paper then ignited.

WHAT WENT WRONG?
(workers to discuss case study, preferably in groups of 5 at each table)

HOW COULD THE INCIDENT HAVE BEEN PREVENTED?

APPENDIX 'A'

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WHMIS
RIGHT TO KNOW

CLASS D1

Poisonous and Infectious Material

MATERIALS CAUSING IMMEDIATE and SERIOUS TOXIC EFFECTS

September, 1988

MODULE D-1 PARTICIPANT'S GUIDE

TERMINAL OBJECTIVE:

The participants will be able to identify the symbol for materials causing immediate and serious health effects, know why and how a material is classified into this division and have a basic understanding of safe handling and emergency procedures for poisonous materials.

PERFORMANCE OBJECTIVES:

The participants shall:

1. **Recognize** the symbol for D-1 materials.
2. **List** examples of acute health effects and three factors that determine the severity of health effects.
3. **List** examples of materials causing immediate and serious health effects.
4. **Explain** why a material would be categorized into this division of Class D.
5. **Explain** the terms LD_{50} and LC_{50} tests.
6. **Identify** general control methods and describe safe handling, use and storage procedures for poisonous materials.
7. **Explain** basic emergency response steps resulting from exposure to or loss of containment of poisonous material.

FLOWCHART

CLASS D-1

INTRODUCTION

CLASS SYMBOLS

IMMEDIATE AND SERIOUS HEALTH EFFECTS

ANIMAL STUDIES AND CLASSIFICATIONS

CONTROL METHODS
SAFE HANDLING PROCEDURES

EMERGENCY RESPONSE PROCEDURES

SUMMARY

MATERIALS CAUSING IMMEDIATE AND SERIOUS TOXIC EFFECTS

Under the Workplace Hazardous Materials Information System, WHMIS, you have the right to know the hazards of materials you work with, how they can affect your health and how to protect yourself. This Guide will help you to work safely with materials which cause immediate and serious health effects.

This Guide will cover:

1) Definitions of Class D, Poisonous and Infectious Material

2) Definition of Class D-1 materials causing immediate and serious health effects

3) Health effects of toxic substances

4) Health effects of Class D-1 materials

5) Toxicity testing

6) Principles of working safely with Class D-1 materials

7) Principles of emergency response

1. WHAT ARE CLASS D MATERIALS?

A material which can threaten life or cause serious injury or illness is classified under Class D - Poisonous and Infectious Materials. There are three Divisions within this class:

Division 1
Materials Causing Immediate and Serious Toxic Effects

Division 2
Materials Causing Other Toxic Effects

Division 3
Biohazardous Infectious Material

2. CLASS D-I

Class D-1 materials are poisonous substances which can cause serious health effects such as loss of consciousness, coma or death within minutes or hours after exposure. Most D-1 materials also cause long-term effects. These are discussed in the Guide on Class D-2 chemicals.

The symbol for Class D-1 is:

The table below lists some examples of D-1 substances and their industrial use.

SUBSTANCE	USE
carbon monoxide	as reducing agent in metallurgy, by-product of combustion of organic materials
sodium cyanide	in electroplating, manufacture of dyes, pigments, used as insecticide
sulphuric acid	as electrolyte in batteries, in electroplating, pickling, in refining of petroleum, in textile industry
toluene-2,4, -diisocyanate (TDI)	in manufacture of polyurethane foams, present in some paints and coatings
hydrogen sulphide	additive in lubricants and cutting oils; by-product of manufacture of dyes, pigments, fertilizers, petroleum refining, and adhesives
hydrogen cyanide	in production of cyanide salts, by-product of electroplating, metallurgy
acrylonitrile	in manufacture of acrylic fibres, nitrile rubber, surfactants, adhesives

3. The Health Effects of Toxic Substances

Chemicals are present and used in every workplace. Some of them are toxic and capable of producing immediate health effects. Those health effects which occur within minutes or hours after exposure are called **acute** health effects. Examples are cough and irritation when exposed to ammonia or headache when exposed to low levels of carbon monoxide, or loss of consciousness or death when exposed to high levels of hydrogen sulphide or carbon monoxide.

Some materials can cause **chronic** problems. The symptoms of chronic exposure become apparent after long periods of time (months or even many years). Chronic health effects are usually caused by repeated, low level exposures. Examples are cancer of the lung when exposed to asbestos, leukemia when exposed to benzene or chronic bronchitis when exposed to acid mist.

4. The Health Effects of Class D-1 Materials

Class D-1 materials are capable of causing immediate and serious health effects including loss of consciousness, coma and death. Not all materials can cause such severe damage. Many factors are important in determining the severity of a material's effect on human health.

These factors include:

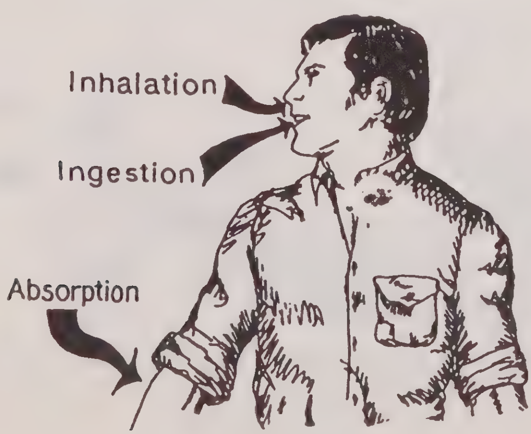
- how toxic the material is
- how much was the worker exposed to
- how long the worker has been exposed
- the route of entry, age and health of worker, etc.

Generally, material which is more toxic will cause more serious health effects. Hydrogen sulphide for example is more toxic than carbon monoxide.

If the concentration of a substance in the air or dose (how much is taken in by the body) is high, the effects will be more serious. Exposure to carbon monoxide at 50-200 ppm may result in a headache, but exposure above 2000 ppm can cause death.

The longer a worker is exposed to a toxic material, the more serious the effect will be. Short exposure to hydrogen sulphide at 50 ppm will cause irritation of the nose and throat, but prolonged exposure at this level may result in a cough, shortness of breath and pneumonia-like symptoms.

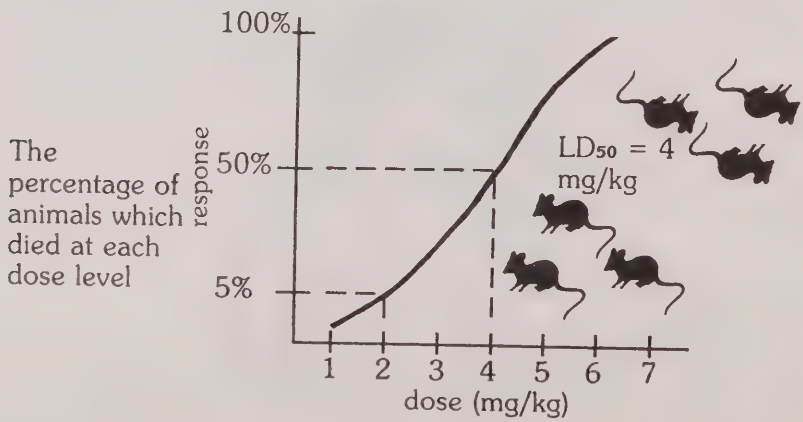
Other factors that can influence the severity of health effects include the age, sex and health of the worker and the route of entry of the material (inhalation, skin contact, swallowing).



5. Toxicity Testing

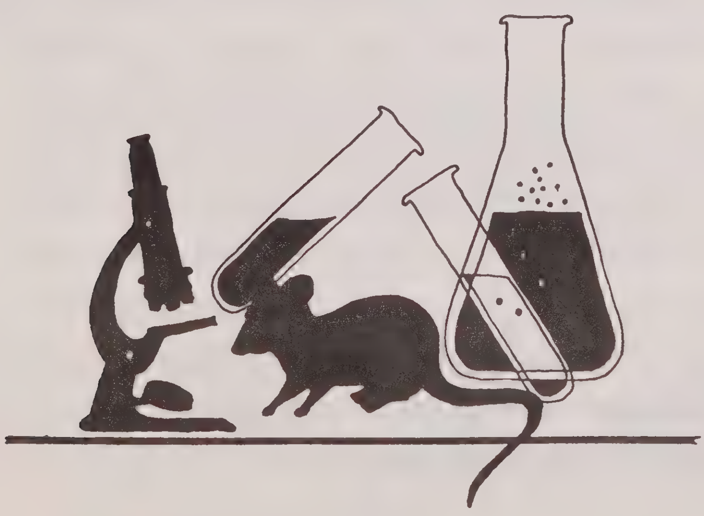
The toxicity of a material is its ability to poison. Some materials are more toxic than others. The toxicity of a material can be determined by various animal studies. To determine the acute toxicity of materials LD_{50} and LC_{50} tests are performed. The animals tested are usually rats or mice although other species can also be used.

LD_{50} (lethal dose, 50%) is a dose of a substance which kills one half of the animals tested. The dose of the material fed to animals is increased until the point is reached where, on average, 50% of them die. This dose, expressed in milligrams per kilogram of the animal's body weight, is the LD_{50} value.
This method can be further illustrated with a graph called dose-response curve.



At a dose of 2 mg/kg only 5 per cent of animals die, but as the dose is increased to 4 mg/kg, 50 per cent of them will be killed.

A similar test (LC_{50}) is done to determine the toxicity of a substance when inhaled. The LC_{50} is the concentration of a substance in the air which kills one-half of the animals exposed. The lower the LC_{50} and LD_{50}, the more toxic a material is. Class D-1 materials have very low LC_{50} and LD_{50} values.
Some chemical mixtures have not been tested to determine if they are poisonous or toxic enough to be considered Class D-1 materials. If the mixture contains more than one per cent of a substance classified as Class D-1, the mixture will also be considered a D-1 material.



6. Principles of Working Safely with Class D-1 Materials

- **Substitute** toxic materials with less hazardous materials if possible. Toluene for example, can be used instead of benzene as a paint thinner.

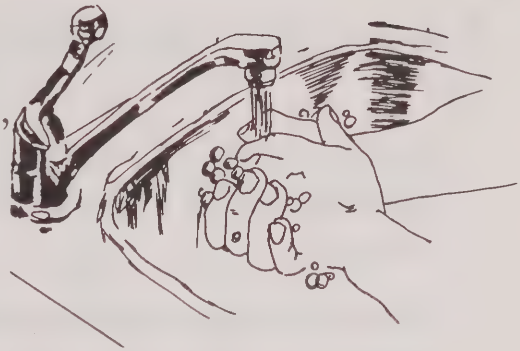
- **Use** exhaust ventilation to remove toxic gases, vapours, mist, dust or fumes from the workplace.

- **Use** proper handling procedures - refer to the Material Safety Data Sheet (MSDS).

- **Store** chemicals in designated areas, away from incompatible materials. Information on incompatible materials can be found in the MSDS. For example if acid and cyanide are stored together and mixed accidentally, hydrogen cyanide will be produced. Hydrogen cyanide is extremely toxic and can kill in seconds.

- **Wear** proper personal equipment made of suitable material. Refer to MSDS for information on personal protective equipment.

- **Use** good hygiene practices:
  - eat, drink or smoke in designated areas only.
  - wash hands before eating, drinking or smoking.

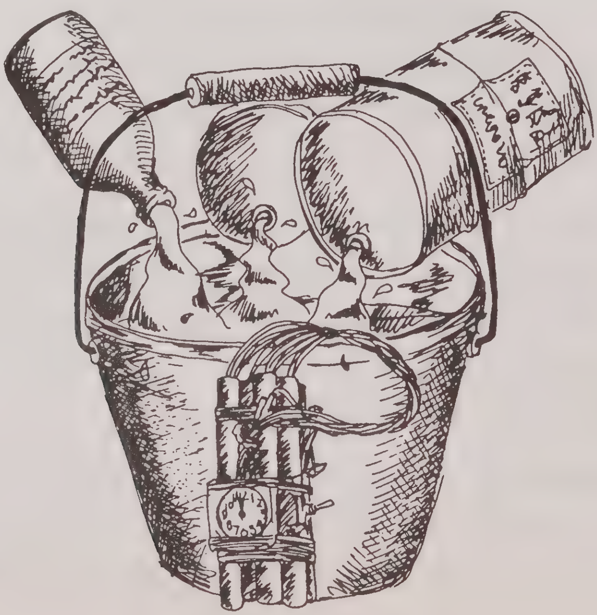


- **Avoid** any direct contact with toxic substances.
- **Know** the hazards of materials you work with.
- Always **refer** to the **MSDS** for information on the health hazards, proper handling procedures, preventive measures and storage requirements of material you work with.
- **Always** follow workplace rules on safe disposal of materials. Remember that when chemicals are mixed together they can give off even more toxic products.
- **Dispose** of poisonous materials in an approved manner. Poisonous materials can become environmental problems.

7. Principles of Emergency Response

Emergency situations can be caused by:

- accidental spills which may cause high concentrations of toxic materials, in the air;
- gas or vapour build-up in enclosed areas;
- accidental swallowing;
- accidental skin contact with chemicals;
- accidental mixing of chemicals;
- fire, involving chemicals.



When emergencies occur:

- follow your company's emergency plan;
- evacuate the area, and assemble at designated place;
- alert other workers and management;
- only specially trained people, with proper equipment should handle the emergency (for example first aiders, emergency response team).

If overexposure to a toxic chemical occurs:

- remove the victim to fresh air;
- call for medical help immediately;
- if the victim is not breathing, see that the breathing passage is clear and start mouth to mouth resuscitation;
- if the heart has stopped (no pulse), start CPR (if trained to do so);
- in the case of skin or eye contact, flush with water for at least 15-20 min;
- follow first aid procedures as described in the MSDS.

Summary

1. Be able to recognize D-1 materials. Remember that they are potentially lethal and overexposure to them can cause death in a short period of time.
2. Read labels and Material Safety Data Sheets for all materials you work with.
3. Avoid direct contact with poisonous substances.
4. Always follow recommended handling and storage procedures for toxic materials.

REVIEW QUESTIONNAIRE

1. Identify the WHMIS symbol for materials causing immediate and serious health effects. (Class D-1)

a. b. c. d. e.

2. A material is lethal when it is: (Please select one response.)

a) capable of causing death within a year

b) capable of causing unconsciousness if exposed to it for eight hours

c) capable of causing death in minutes or hours

3. What are the two animal tests performed to determine how toxic a substance is?

4. Which of the following substances is the most toxic?

   a) hydrogen sulphide LC_{50} (rats) 444 ppm, 4 hour exposure

   b) toluene-2, 4-diisocyanate LC_{50} (rats) 14-50 ppm, 4 hour exposure

   c) carbon monoxide LC_{50} (rats) 1807 ppm, 4 hour exposure

5. List four factors which determine the severity of exposure:

6. If you find an acid drum stored on top of a cyanide drum in the storage area, what would you do? Indicate the correct response.

   a) ignore - there is no danger

   b) make a note and inform Joint Health and Safety committee on their next meeting

   c) alert supervisor and other workers immediately

   d) get fork lift truck and remove acid drum

7. Please indicate if the following statements are true or false.

Substitution with a less hazardous substance is a good way to control exposure to toxic materials.	T	F
Ventilation is used to remove airborne toxic contaminants from the workplace.	T	F
Information on protective equipment may be found on labels.	T	F
Good hygiene practices will prevent inhalation of toxic chemicals.	T	F
All chemicals have a smell which can warn about their presence in the atmosphere.	T	F
In case of large chemical spill, the first step to take is to evacuate the area.	T	F

8. List three first aid measures to be taken in case of accidental poisoning by inhalation.

APPENDIX 'A'

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CLASS D^2

Poisonous and Infectious Material

MATERIALS CAUSING OTHER TOXIC EFFECTS

September, 1988

MODULE D-2 — PARTICIPANT'S GUIDE

TERMINAL OBJECTIVE:

The participants will be able to recognize a Class D, Division 2 material, identify the toxic effects, and know how to work safely under normal and emergency conditions.

PERFORMANCE OBJECTIVES:

The participants will be able to:

1. **Recognize** the symbol for Class D, Division 2 material.
2. **Provide** examples of Class D, Division 2 materials.
3. **List** some factors influencing the severity of health effects of exposure to substances.
4. **Identify** the possible toxic effects of Class D, Division 2 materials.
5. **Indicate** how exposure to D-2 materials can be prevented during normal and emergency situations.
6. **Identify** actions to be taken should an over-exposure occur.

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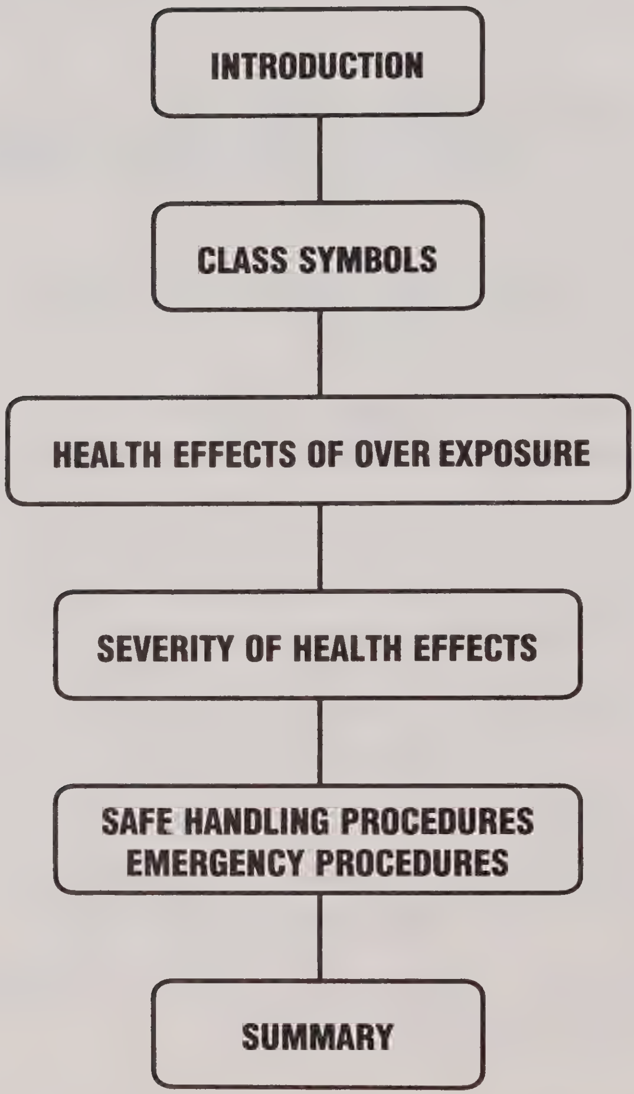
CLASS D-2



Under the Workplace Hazardous Materials Information System, WHMIS, you have the right to know the hazards of materials you work with, how they can affect your health and how to protect yourself. This guide will help you to work safely with Class D-2 toxic materials. It provides the basic resource material to be used during the training program and can be used as a permanent resource after the program.

Six main subject areas are covered:

1. What are Class D-2 materials and where are they found?
2. How to recognize the hazard symbol.
3. What makes Class D-2 materials toxic?
4. The health effects of Class D-2 materials.
5. Principles for working safely with Class D-2 materials.
6. Principles of emergency response when working with Class D-2 materials.

1. What are Class D-2 Materials and where are they found?

Under WHMIS, a material which can threaten life or cause serious injury or illness is classified under **Class D - Poisonous and Infectious Material**. There are three Divisions within Class D.

- Division 1 - Materials Causing Immediate and Serious Toxic Effects
- Division 2 - Materials Causing Other Toxic Effects
- Division 3 - Biohazardous Infectious Material

Class D-2 materials include **materials causing all health effects other than those which are both serious and immediate.** The effects of Class D-2 chemicals range from less serious immediate effects (skin and eye irritation) to serious long-term toxic effects like cancer and reproductive effects.

The toxic effects which occur immediately with a single exposure, are called **acute**. Chronic or long-term toxic effects may not show up until days, weeks or years after repeated exposure.

The table below lists some examples of D-2 chemicals and their industrial use.

EXAMPLES OF CLASS D-2 MATERIALS

MATERIALS		USE
Liquids	– acetone	solvent
	– benzene	solvent, chemical manufacturing
	– mercury	drugs, dyes, explosives
Gases	– propane	fuel
	– ethylene oxide	sterilizing agent, chemical manufacturing
Solids	– quartz (silica sand)	sand blasting, moulds in foundry
	– asbestos	insulation, fire proofing
	– lead	metal smelting, welding, paints, battery manufacturing
	– cadmium	electroplating, solder

2. How to recognize a Class D-2 Material

You can recognize a Class D-2 material by the hazard symbol. It is a specific and unique symbol and only applies to Class D-2 materials.

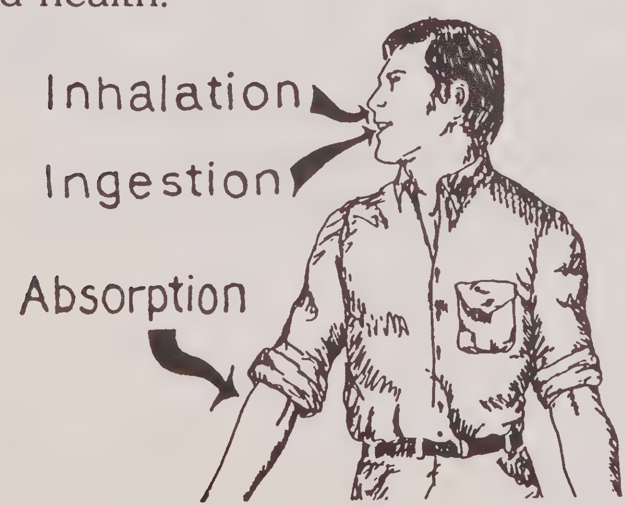
You will find this symbol on the labels of Class D-2 materials in your workplace. This symbol will warn you about the special hazards when using, handling and storing the material. **When you see this symbol,** you will know special precautions are required for handling, and that you must follow the safe work procedures for that substance. The label will also refer to the Material Safety Data Sheet (MSDS) which provides more detailed information on that product.

3. What makes Class D-2 Materials toxic?

Class D-2 materials are toxic because they can cause harmful health effects. The amount of harm the material can cause will depend on a number of factors.

These include:

- how the material enters your body;
- the amount or dose entering your body;
- how toxic the material is;
- how easily it is removed from your body, and;
- individual differences such as age, sex and health.



4. The Health Effects of Class D-2 Materials

Hazardous materials enter the body by several routes of entry (e.g. breathing, swallowing, skin absorption). The way in which a material enters the body and the toxic effects of exposure are given in the toxicological properties or health effects section of the MSDS. The toxic effects of Class D-2 material include:

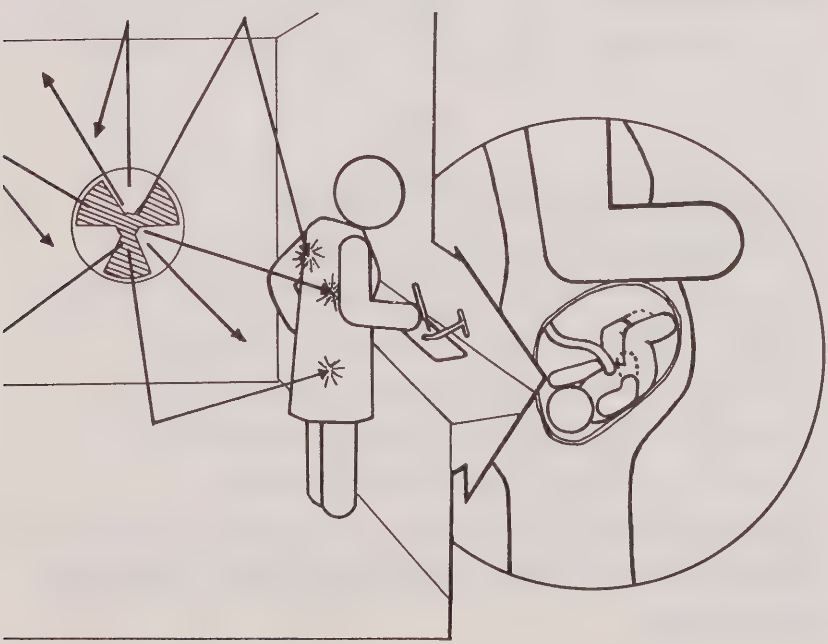
1. Chronic Toxic Effects

Some materials may not show a harmful effect after the first exposure. However, repeated exposures over a long time may cause disease. These chronic effects can cause death or serious permanent illness. For example, the chronic toxic effects of exposure to **asbestos** include asbestosis (scarring of the lung), and lung cancer. Other materials causing chronic effects include **silica** which may cause silicosis and **mercury** which may cause damage to the nervous system.

2. Teratogenicity and Embryotoxicity

Teratogenicity is the ability to cause birth defects. **Embryotoxicity** indicates if the material can cause harm to the embryo.

If you become exposed to materials which cause these effects, you may not observe any effect to your own health. However, when the material is absorbed into your body, it can be passed on to the embryo or foetus where it causes damage.



Do you remember the thalidomide babies? Those birth defects were due to the drug, thalidomide, taken by mothers. Although not as severe, some workplace materials such as **lead** and **mercury** may cause similar effects.

3. Carcinogenicity

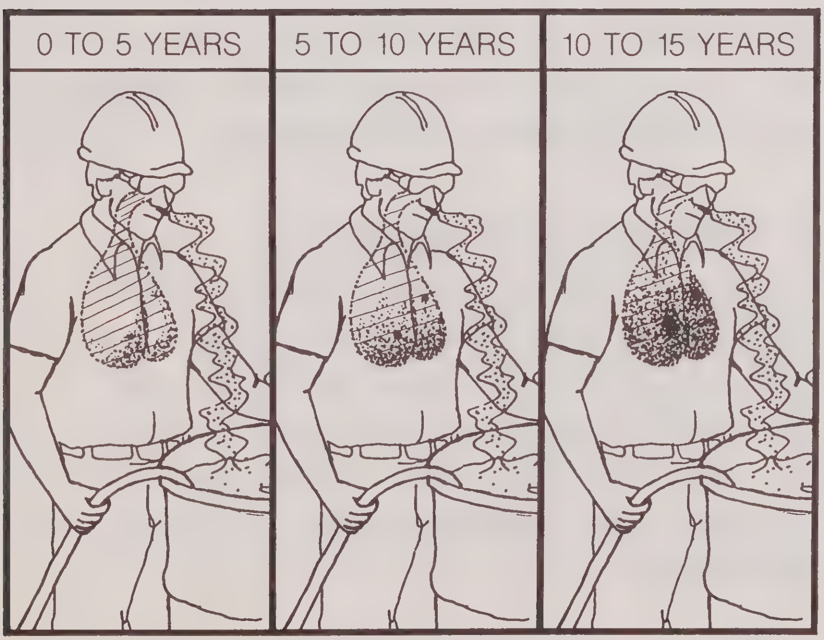
This is the ability of a material to cause cancer. These substances, carcinogens, cause changes to the basic structure of cells and tissues which may result in abnormal growths. Workplace carcinogens include **benzene** which may cause leukaemia, **vinyl chloride monomer** which may cause liver cancer and **asbestos** which may cause lung cancer.

4. Reproductive Toxicity

Some materials show a specific toxic effect on the reproductive system. This effect may occur in either the male or female. These materials may cause sterility or impair the reproductive system causing reduced fertility, miscarriages, and birth defects. Examples of such materials are **lead** and **methyl mercury**.

5. Respiratory Tract Sensitization

Sensitization is the development, over time, of an allergic reaction to a chemical. The chemical may cause a mild reaction on first exposure but the reaction becomes more serious on repeated exposures. Materials which cause these severe asthma-like symptoms include **isocyanates** and **cotton dust**. Symptoms include wheezing, chest tightness, coughing and shortness of breath.



6. Mutagenicity

This is the ability of the material to cause changes in the genes, the building blocks of cells, which normally determine which feature a child will get from its parent. Changes in the genes may be passed on to the worker's children.

Changes in the genes may also increase the risk of cancer and reproductive problems such as infertility or birth defects.

Materials which cause this effect, mutagens, may also cause cancer.

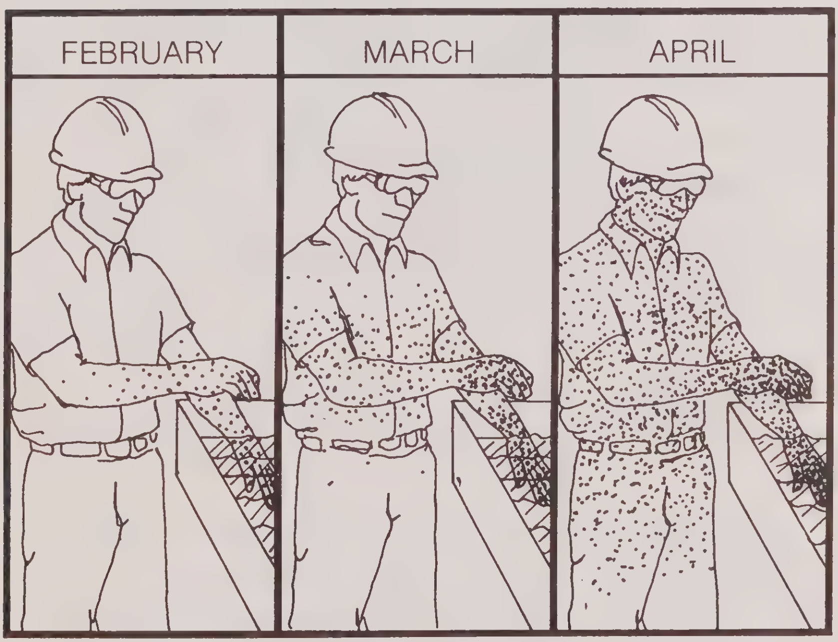
Examples of workplace materials which can cause mutations are **lead**, **ethylene oxide, benzene and styrene.**

7. Skin and Eye Irritation

Some materials cause irritation of the skin, eyes, nose and throat. Signs and symptoms include tearing of the eyes, reddening, swelling, itching and pain of the affected body part. Examples of such material are **ammonia gas**, **acids** and **caustics**.

8. Skin Sensitization

Sensitization of the skin is the development of an allergic reaction to a chemical. The reaction is usually more severe after repeated exposures. Symptoms include swelling, redness, pain, blistering and itching. **Nickel salts** and **epoxy resins** can cause allergic dermatitis, inflammation of the skin.



9. Untested Mixtures

Many chemical mixtures have not been tested for their toxic effects. A mixture is classified as a D-2 material if any of its **tested** ingredients is present in a concentration of more than:

(a) 0.1% for chemicals which have effects such as teratogenicity and embryotoxicity, carcinogenicity, reproductive toxicity, respiratory tract sensitization and mutagenicity. (Any of sections 53 to 57 of the Control Products Regs.)

(b) 1% for substances causing other chronic toxic effects. (Section 52 of the Control Products Regs.)

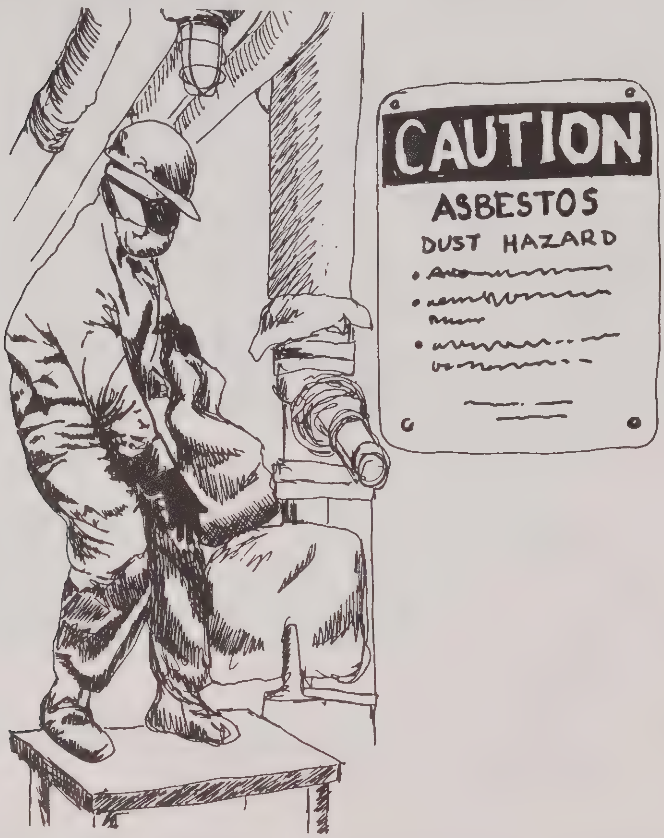
5. Principles for working safely with Class D-2 Materials

The first step is to make sure that you are trained in the proper procedures for both your normal work activity and emergency conditions such as spills and leaks. Some materials may belong to several hazard Classes, for example, **gasoline** which belongs to Class D-2 and Class B – flammable and combustible material; **hydrogen peroxide** belongs to Class C, Class D-2, Class E and Class F.

Consult the MSDS if you do not have enough information or ask your supervisor. Some **general safe work principles** are:

- **Know** the hazards and properties of the material you work with.
- **Make sure** you are properly trained in correct work procedures — normal and emergency situations.
- **Know** the symptoms of exposure, e.g. skin rash.

- **Know** what to do if exposed to the material — inform your supervisor, seek medical attention.
- **Ensure** that controls provided are used, e.g. ventilation.

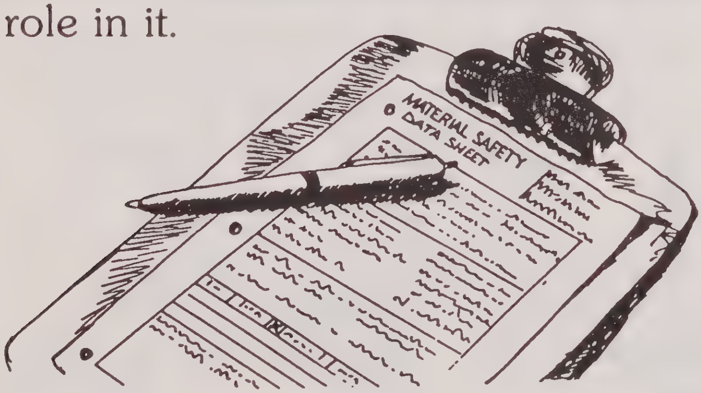


- **Use** the correct personal protective equipment to prevent exposure, e.g., goggles, gloves, coveralls.
- **Know** what to do in an emergency with this material, e.g., spill, leak, fire.

6. Principles of Emergency Response

You should be aware of your company's procedures for handling any emergency situation. These procedures will indicate whether specially trained personnel should respond and under what conditions. This is important because you could become exposed to a toxic material during an emergency. You can protect yourself if you:

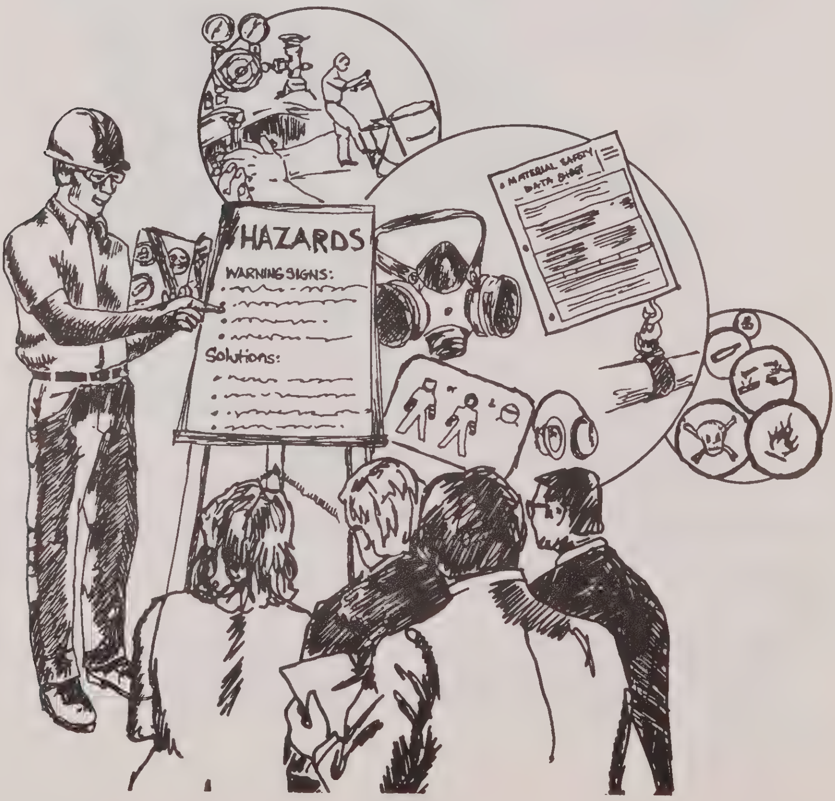
- **Know** the emergency plan and your role in it.



- **Refer** to the MSDS for specific information on emergencies.
- **Know** the First Aid treatment or know who is qualified in first aid.
- **Seek** medical attention if you become contaminated or exposed to a toxic material.

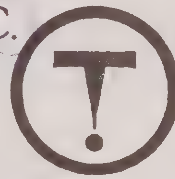
SUMMARY

In this module you have learned that hazardous materials can cause many serious toxic effects. The amount of harm depends on how much material you are exposed to and for how long. You can therefore protect yourself by following the safe work procedures required for the job. These procedures and the use of proper control measures in the workplace will help to prevent exposure to toxic materials. **Be informed and work safely!**



SELF-EVALUATION QUESTIONNAIRE

1. The Hazard Symbol for WHMIS, Class D-2 is______? Select one response.

A.  B.  C.  D. 

2. Toxic means, "Able to cause the body______________________________."

3. Which of the following materials belong to Class D-2? Check all responses that apply.

hydrogen sulphide	☐
acetone	☐
measles	☐
salt	☐
silica	☒

4. Please indicate whether the following statements are true or false.

(a) Exposure to asbestos can cause lung cancer. T F

SELF-EVALUATION QUESTIONNAIRE (cont'd)

(b) Silica can cause reproductive effects. T F

(c) The effect of toxic material depends on the dose to the body. T F

5. Fill in the blanks with the appropriate word:

   a) Chronic toxic effect refers to ______________ term harmful effects.

   b) Mutation can cause changes in the building blocks of ______________.

   c) Exposure to benzene may cause ______ leukemia ______.

   d) Dry, itching skin or skin rash may be due to ______________.

   e) Wheezing and difficulty in breathing may be caused by sensitization of the ______ respiratory ______ tract.

APPENDIX 'A'

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CLASS D[3]

Poisonous and Infectious Material

BIOHAZARDOUS
INFECTIOUS
MATERIAL

September, 1988

MODULE D-3 — PARTICIPANT'S GUIDE

BIOHAZARDOUS INFECTIOUS MATERIAL

Under the Workplace Hazardous Materials Information System, WHMIS, you have the right to know the hazards of materials you work with, how they can affect your health, and how to protect yourself. This guide will help you to work safely with biohazardous infectious materials. It provides the basic resource material to be used during the training program and can be used as a permanent resource after the program.

Six main subject areas are covered.

1. What are biohazardous infectious materials?
2. Where can they be found?
3. How can you be exposed?
4. What are the health effects?
5. Principles for working safely with biohazardous infectious material.
6. Principles of emergency response.

FLOWCHART

CLASS D-3 - BIOHAZARDS

INTRODUCTION	Brief overview of WHMIS Hazard Classifications and symbols Class D-3 - Biohazardous Infectious Materials
GENERAL INFORMATION	— What biohazardous materials are and what occupations are they associated with — Examples of biohazardous infectious materials
HAZARDS INVOLVED	— Basic properties (etiology) and potential to infect humans (pathology) — How workers may be exposed on the job
HEALTH EFFECTS	— Mode of entry into, and effect on the human body — acute toxic effects — chronic or long-term effects
SELF PROTECTION	— Safe handling, including basic work practices, storage and disposal procedures as well as emergency response measures
FURTHER SOURCES OF INFORMATION AND SUMMARY OF SESSION	— texts, journals, bulletins, safety organizations, labour organizations, government

TERMINAL OBJECTIVE:

At the end of the training session, the participants will have some basic understanding and knowledge of biohazardous infectious materials including the possible adverse health effects of the materials as well as the basic procedures for control, safe handling, storage, disposal and for emergency situations involving these materials.

PERFORMANCE OBJECTIVES:

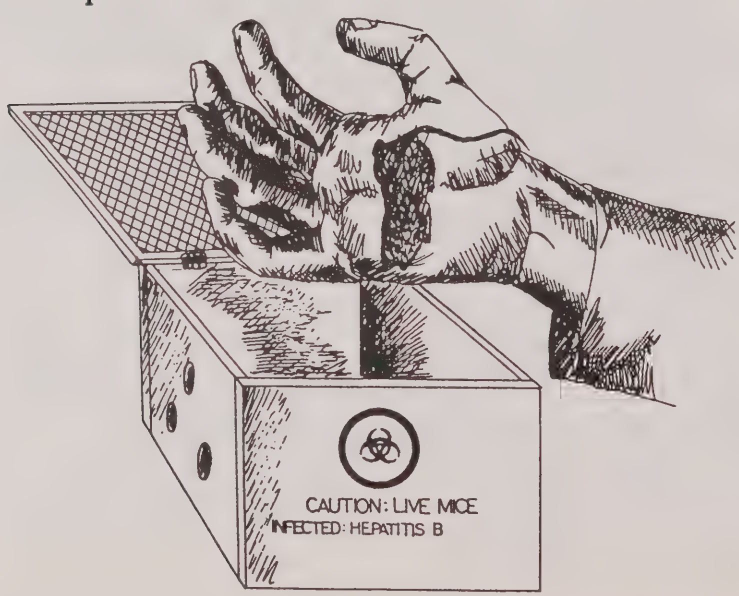
The participants will be able to:

1. **Recognize** the Class D-3 symbol for biohazardous infectious materials.
2. **Give** the definition of biohazards, list their categories, and explain where biohazardous materials may be found and identify some of the occupations where an exposure could occur.
3. **Describe** some of the basic properties of biohazards, and discuss how exposure occurs.
4. **Explain** some of the possible adverse health effects associated with biohazards, including the mode of entry into the body.
5. **Explain** what is meant by self protection including some general control measures, safe handling, including basic work practices, storage and disposal procedures for biohazards.
6. **Explain** what general principles to follow in emergency situations involving biohazardous infectious materials.

1. WHAT ARE BIOHAZARDOUS INFECTIOUS MATERIALS?

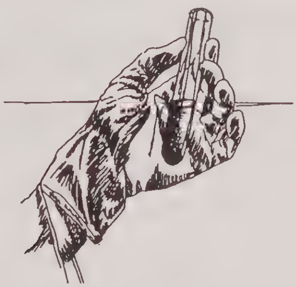
Biohazardous infectious materials are any organism, or its toxins, that has been shown to cause disease or is believed to cause disease in animals or people. Organisms which cause disease in animals are of particular concern especially if the disease can be transmitted from animal to man. Examples of these organisms include:

- bacteria
- viruses
- fungus
- parasites



What are Bacteria?

Bacteria are microscopic organisms living in soil, water, organic matter, or the bodies of plants and animals and are often composed of a single cell in the form of straight or curved rods (bacilli), spheres (cocci) or spiral structures. Disease-producing bacteria are infectious organisms that cause such diseases as pneumonia, tuberculosis, syphilis, and typhus. Other examples are found in the Categories of Biohazards chart on page 8.



What are Viruses?

An infectious agent which differs from other micro-organisms in that they are only half alive, they lack metabolism, are unable to use oxygen or to grow or die. They are like parasites, relying on a living host cell. They account for many diseases including: mumps, measles, scarlet fever, small pox, influenza and possibly the common cold. Other examples are found in the Categories of Biohazards chart on pages 8 and 9.

What are Parasites?

Parasites are organisms that take their food from a living plant or animal host. Parasites themselves do not necessarily cause disease; but may spread the disease between animals and man. Some examples of parasitic diseases are: malaria, amoebiasis, trypanosomiasis and schistomiasis. Other examples are found in the Categories of Biohazards chart on pages 8 and 9.

What is a Fungus?

A fungus is any major group of lower plants that lack chlorophyll and live on dead or other living organisms. Fungi include mould, mildews, smuts and mushrooms. The incidence of fungal disease of an occupational nature is not great and is mainly confined to farmers, outdoor workers and animal raisers. Some examples of fungal diseases are: histoplasmosis, candidiasis and aspergillosis. Other examples can be found on the Categories of Biohazards chart on pages 8 and 9.

NO "SAFE" LIMITS OF EXPOSURE TO BIOHAZARDOUS MATERIALS HAVE BEEN DETERMINED.

The hazard symbol for Class D-3, Biohazardous Infectious Material is:

2. WHERE CAN BIOHAZARDOUS MATERIALS BE FOUND?

Biohazardous infectious materials can be found in many workplaces. Health care workers, laboratory workers, farmers, veterinarians, poultry and livestock workers are examples of workers who are in daily contact with class D-3 materials.

Listed below are the **categories of biohazards,** diseases they may cause and the occupations with which they are associated.

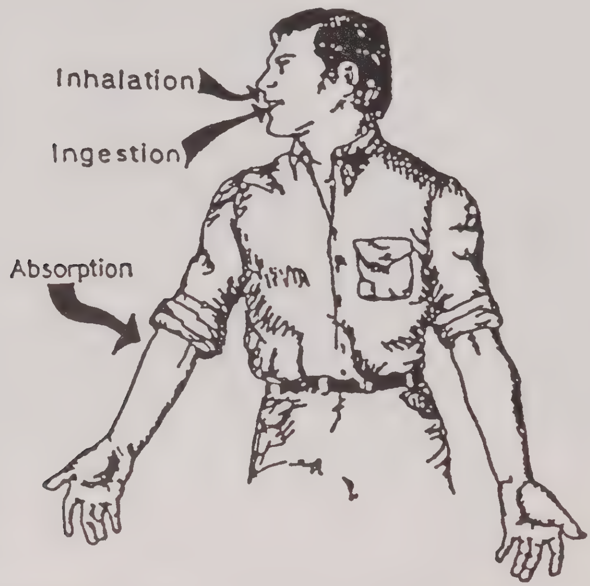
AGENT	DISEASE	POTENTIAL OCCUPATIONAL EXPOSURE
(a) bacteria:	Tetanus Brucellosis	- any worker with dirty, untreated cut, wound - meat packers, livestock producers, marketers, veterinarians, inspectors
(b) viruses:	Hepatitis B	- health care workers, lab workers
(c) fungi:	Farmer's lung Bagassosis	- farmers handling hay, sawmill operators - sugar cane workers
(d) parasites: mites, chiggers and ticks	Ascariasis, Creeping Eruption, Swimmer's Itch, Hookworm	- construction workers, linemen, surveyors, poultry workers, farmers, potters, trappers
(e) rickettsiae:	Rocky Mountain Spotted Fever, Q fever	- foresters, lumberjacks, trappers, hunters, resort operators

(f) chlamydia:	Psittacosis	- dairy farmers, stockyard workers, slaughterhouse workers, hide and wool workers, hide and wool handlers, laboratory workers
(g) allergens *from animal and plant sources*	Skin Dermatosis	- farmers handling fruit, vegetables, plants, weeds such as poison ivy, grain elevator workers, tobacco workers, lab workers
from inhalation of antigens in dust	Byssinosis	- grain and cereal workers, forestry workers, furniture workers, flax workers
(h) recombinant products: genetic material such as DNA and RNA	Gene Mutation	- biomedical workers (scientists and laboratory workers)

3. HOW CAN YOU BE EXPOSED?

The most common ways biohazards can enter the body are:

- by mouth (ingestion)
- by the skin (puncture, penetration)
- by the lungs (respiration)



Respiratory exposure accounts for 65%-75% of all infections. This can occur from airborne bacteria, viruses, or allergens. Many infections acquired by laboratory workers are caused by accidental exposure to biohazardous material and to animals which are infected with disease. A research scientist can accidentally infect himself or herself with a particularly virulent virus, through a break in the skin if a laboratory culture dish is dropped.

4. WHAT ARE THE HEALTH EFFECTS?

If you are exposed to biohazardous infectious material, you could suffer from a wide variety of symptoms. Whether or not disease occurs will depend on the type of biohazardous agent, the route of exposure and how resistant the worker is to disease.

Some examples of **adverse health effects** include:

INFECTIOUS AGENT AND CAUSE	SYMPTOMS	DISEASE
bacteria enters break in skin from crush or penetrating wound	painful muscle spasms, death if untreated	Tetanus or Lockjaw
virus enters break in skin of health care worker attending to a patient with Hepatitis B	varied include flu-like symptoms, rash, fatigue, lack of appetite, possibly nausea and vomiting, and jaundice	Hepatitis B (HBV)
rickettsiae organism — tick bites man	local swelling and itching and rash of the skin, fever, headache, sore muscles, chills, eye infection, can be fatal (20% of cases)	Rocky Mountain Spotted Fever

If you think you have been exposed to biohazards in your workplace, report any concerns or symptoms to your doctor, or to the employee health centre. Don't just forget about it. You could harm your health.

5. PRINCIPLES FOR WORKING SAFELY WITH BIOHAZARDOUS INFECTIOUS MATERIAL.

Protecting yourself means being aware of the hazards, and knowing the procedures for safe handling, storage and disposal, as well as what to do in an emergency situation. It also means keeping your immunization schedule up to date. Ask your supervisor or your joint health and safety committee/biohazard committee representative if you are unsure about the materials with which you are working.

Below are some important points to remember when working with class D-3 materials.

Safe Handling Procedures, Basic Work Practices

Follow your company's safe operating procedures for handling the particular

materials with which you are working. Every hospital, laboratory and research centre should follow established guidelines for safety.

Some specific work practices include the following:

IN THE LABORATORY/HOSPITAL:

- **Work** only with specimens which are clearly labelled.
- **Check** that all equipment used is operating normally.
- **Use** the necessary protective equipment (gloves, face, eye protection, respirator).
- **Do not wear** your lab coat outside the work area because this helps to spread germs.
- **Do not take** food, drink or tobacco into the work area, because they are too easily contaminated.
- **Dispose** of instruments (needles, culture dishes) in accordance with your company's/institution's safety guidelines.

- **Biohazardous warning labels** should be on the door of work area, refrigerators, etc.
- **Never use** a mouth pipette.
- **Avoid** contamination of your work surface area.
- **Always practise** aseptic techniques.
- **Report** any accident, particularly where there has been a personal injury to the worker.
- Handle **all** specimens as though they were infectious.

ELSEWHERE:

- **Handle** animals, plants, vegetables, birds, etc. with care. Any one could be a source of infection.
- **Wear** the necessary protective clothing.
- **Always practise** good personal cleanliness.
- If you receive a cut, bite or are otherwise exposed, **seek** prompt treatment.

- In hospitals, patients with active disease should be **isolated** to prevent others from being infected.

These are only a few of the important points related to the safe handling of biohazardous infectious materials. You must be aware of **all** of the safe work practices associated with your particular work environment.

Principles of Storage of D-3 Materials

IN THE LABORATORY/HOSPITAL:

- **Accumulate** and **store** materials separate from current and past experiments.
- **Never store** food or beverages in your work area.
- **Infectious waste** should be well packaged, and stored for no longer

than 24 hours at room temperature, 3 days in a refrigerator, and 90 days in a freezer.

- **Storage areas** are off limits except to those workers whose job it is to store and dispose of biohazardous waste.
- **Good housekeeping** should be practised in the storage area, and the area should be isolated and specially designed to treat waste.
- A **biohazard label** should be attached to the door of storage and waste material areas.

Disposal Procedures

- **Clinical waste** from hospitals, laboratories, and dental offices should be disposed of under strict controls.
- **Disposal methods** include incineration and steam sterilization to decontaminate the biohazardous material.
- **Workers** involved in the disposal of biohazardous wastes **should be fully trained** in the safe procedures for disposal.

- Always **adhere to the guidelines** set up by your workplace BIOHAZARD COMMITTEE.

6. PRINCIPLES OF EMERGENCY RESPONSE

Remember, most accidents involving biohazards are preventable.

IN THE LABORATORY:

- **Report** any spills, leaks or lack of containment of biohazardous infectious material immediately.
- The **spill** should be contained, disinfected, and packaged after mopping it up with paper towels.
- The **worker** should wear gloves when cleaning a spill to ensure that no glass particles cut the hands.
- **Keep** unnecessary people out of the area when a lack of containment occurs.
- Be sure to **follow** the recommended emergency procedures for your workplace. If there is an Emergency

Response Team contact them in addition to your supervisor.

- **Remember** that any delay in cleaning a spill, may place you and your co-workers in danger.

ELSEWHERE:

- If you receive a cut, bite or are otherwise exposed **seek** prompt medical attention.
- When any of the symptoms described in this guide appear, **seek** prompt medical attention.

SUMMARY

The topics reviewed in this reference guide include the following:

- what biohazardous infectious materials are
- where biohazards are found
- how exposure occurs
- adverse health effects

Questionnaire #1

Please indicate whether the following statements are true or false:

1. As long as biohazardous waste is well packaged and securely tied, it can be safely stored at room temperature, for up to one week. T F
2. Wet heat, or steam sterilization is the most dependable method of destroying biohazardous micro-organisms. T F
3. Storage and disposal areas containing biohazardous waste are off limits to unauthorized personnel. T F
4. It is essential for all personnel to leave laboratory coats and uniforms inside the work area when going to food breaks or when leaving the facility. T F
5. A farmer who wears appropriate personal protective equipment is practising primary prevention of disease, where biohazardous agents are concerned. T F
6. Self protection means being aware of the particular biohazardous agents in your own work place and practising safe handling procedures. T F

Questionnaire #2

Please indicate whether you agree or disagree with the following statements.

	Agree	Disagree
1. A worker who has sustained a cut at work, should ensure that he or she gets emergency first aid, to avoid any further contamination.	☐	☐
2. A nurse in the operating room had some blood spilled on her nylons when a bag of blood spilled on the floor. She left the operating room straight away, to get the operating room cleaner to clean up the blood spill immediately.	☐	☐
3. A worker in a sawmill develops shortness of breath, wheezing, coughing, tightness in his chest. When he returns to work on Monday, after the week-end at home he feels worse. This worker should take home remedies to relieve the symptoms.	☐	☐
4. In a small research laboratory, a rodent which had been injected with a cancer-causing virus, jumped off the table, scampered out the room and down the hall to freedom. The staff sealed off the immediate area, to corner the animal so that it would be caught, even though the animal had only just been injected and had no symptoms of illness.	☐	☐
5. Workers in pig and poultry processing plants, food handlers such as cooks, chefs, etc., must be extremely careful about personal hygiene to ensure that they do not get, or spread salmonella bacteria to uninfected meat products, to the members of their own household, or to the public, who will consume the products.	☐	☐
6. Workers who are trained how to respond in an emergency situation in the lab, or in other workplaces where biohazards can cause harm, and who are trained in health effects of the materials, are better able to protect themselves at work.	☐	☐

APPENDIX 'A'

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WHMIS

RIGHT TO KNOW

CLASS E

CORROSIVE MATERIAL

September, 1988

MODULE E — PARTICIPANT'S GUIDE

TERMINAL OBJECTIVE:

The participants will have a basic knowledge of the hazards, health effects, methods of control and emergency procedures for corrosive materials so that they can work safely with corrosives.

PERFORMANCE OBJECTIVES:

The participants shall:

1) **recognize** the class symbol;
2) **explain** what a corrosive material is;
3) **give examples** of corrosive materials and their use;
4) **identify** the hazardous properties of corrosives;
5) **explain** health effects and symptoms of exposure to corrosives;
6) **identify** general control methods and describe safe handling, use and storage procedures for corrosives;
7) **explain** emergency procedures.

FLOWCHART

- INTRODUCTION
- CLASS SYMBOL
- PROPERTIES, HAZARDS, HEALTH EFFECTS
- PROCEDURES FOR SAFE HANDLING
- EMERGENCY RESPONSE PROCEDURES
- SUMMARY

Class E - CORROSIVES

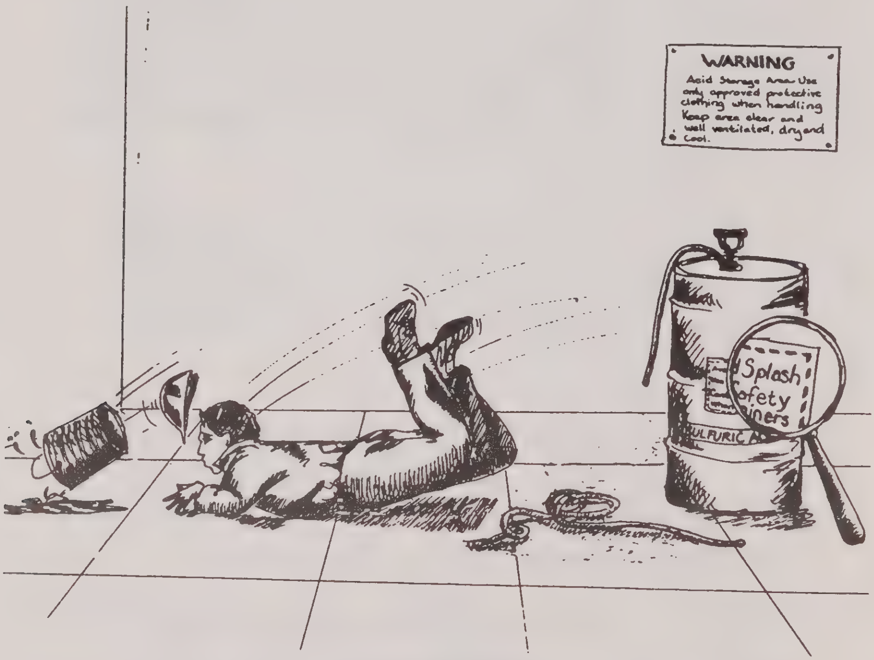
Under the Workplace Hazardous Materials Information System, (WHMIS), you have the right to know the hazards of materials you work with, how they can affect your health and how to protect yourself. This guide book will help you to work safely with corrosives. It provides the basic resource material to be used during the training program and it can be used as a handy reference guide after the program.

This guide will cover five main subject areas:

1. What are corrosives?
2. Examples of corrosives.
3. Health effects and hazards.
4. Controlling Exposure — Principles of working safely with corrosives.
5. What to do in emergencies involving corrosives.

1. What are corrosives?

Corrosives are materials that can attack and destroy on contact human tissue, clothes and other materials — even metals. They can be in the form of gas, liquid or solid. Most are either acids or bases although some other chemicals are corrosive too.



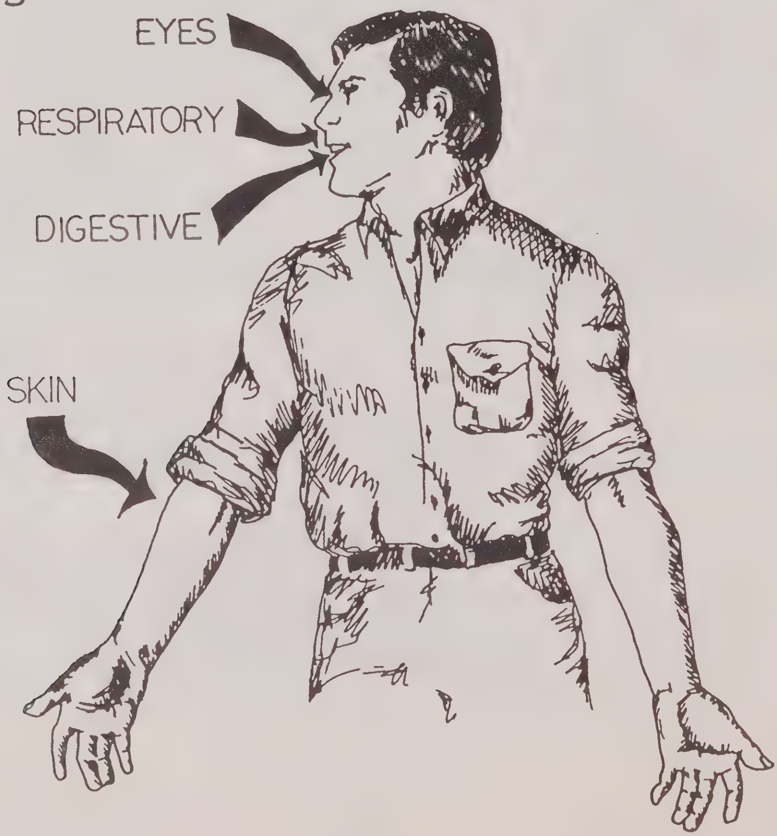
2. Examples of Corrosives

Corrosives are present in almost every workplace. The table on the next page gives some examples and their common use.

CORROSIVE	USE
Acids:	
Sulphuric acid	- electroplating, soap manufacturing, batteries, chemical industry
Nitric acid	- electroplating, explosives industry
Hydrochloric acid	- pickling of metals, leather tanning, petroleum, textile, chemical industries
Chromic acid	- decorative chromium plating
Bases:	
Ammonium hydroxide	- in fertilizers, cleaners
Sodium hydroxide (caustic soda)	- oil refining, cleaning agents, electroplating, soap manufacturing
Potassium (caustic potash or lye)	- electroplating, as neutralizing agent hydroxide
Other corrosives:	
Calcium oxide (lime)	- in sewage and water treatment, rubber industry
Chlorine	- as bleaching agent, disinfectant, in pulp and paper industry, petroleum refineries
Nitrogen dioxide	- welding by-product, emitted in acid dipping operation
Ammonia	- in refrigeration units, blue printing, electroplating, pulp and paper, rubber industries

3. Health Effects and Hazards

All corrosives can burn skin, and other tissues. They begin to cause damage as soon as they touch the human body. The skin, eyes, respiratory system and digestive tract are most likely to be damaged. Health effects and symptoms of exposure depend on many factors such as the type of corrosive, what part of the body was exposed and for how long.



Some of the health effects and symptoms of exposure to corrosives are:

Skin contact

MILD EXPOSURE:

- can cause irritation dermatitis (itchy, red skin),
- can sensitize the skin which leads to allergic reaction even with the smallest exposure

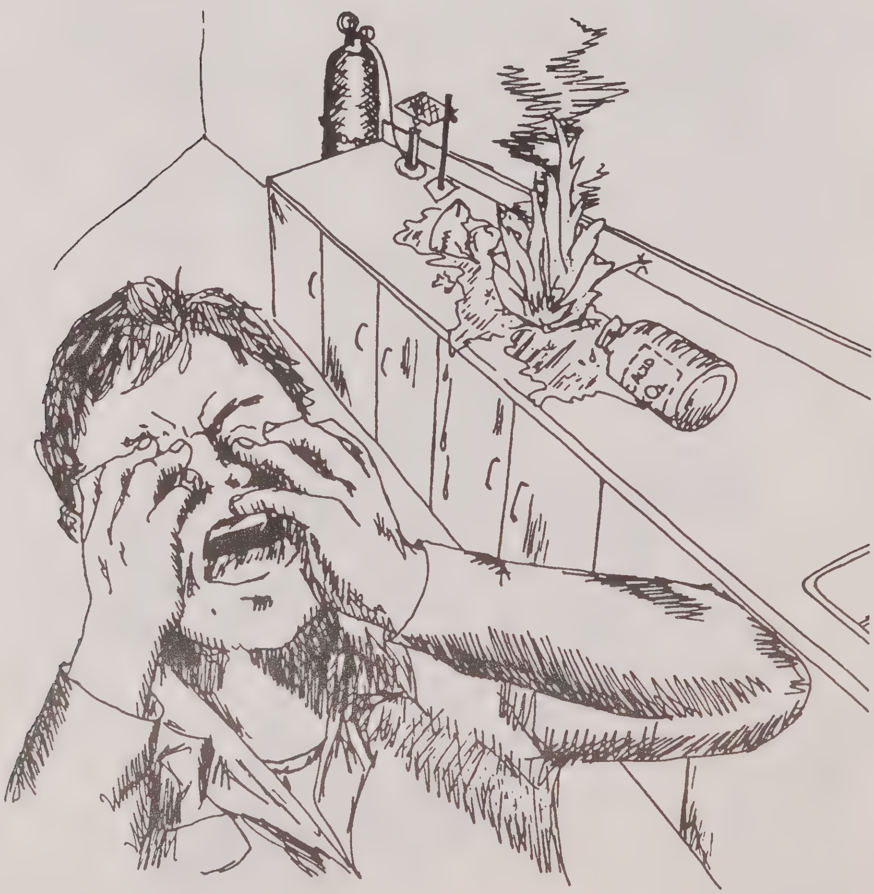
SEVERE EXPOSURE:

- a corrosive splash can immediately burn and blister your skin,
- may penetrate deeper causing more damage

Eyes

MILD EXPOSURE:
may cause burning, watery eyes, irritation or eye inflammation

SEVERE EXPOSURE:
a corrosive splash can burn your eye causing clouding, scarring and blindness



Respiratory system (inhalation)

MILD EXPOSURE:
cough, irritation of nose, mouth, throat and damage to the lining of airways

SEVERE EXPOSURE:
heavy chest feeling, chest pain, difficulty in breathing, pulmonary edema (fluid in your lungs), death

Digestive tract (swallowing)

SMALL AMOUNT:
irritation, burns to sensitive lining of mouth, throat, stomach

LARGE AMOUNT:
severe burns, scarring, death

Other hazards of corrosives

Corrosives damage materials other than human tissue which can also create health and safety hazards for workers. For example, many **corrosives can damage metals.** Contact with corrosives can damage containers, equipment and installations made from certain materials.

Common bases such as sodium hydroxide and potassium hydroxide can

attack metals such as zinc or aluminum and produce explosive hydrogen gas.

Corrosives may also **react violently** when they come into contact with other chemicals or water creating toxic or explosive products. For example, a glass of water thrown into a bucket of concentrated sulphuric acid is converted instantly to steam which will eject the bucket's contents.

Certain **strong corrosives may**, on contact with other substances **cause fire or explosion**. For example, strong nitric acid may ignite wood, paper, turpentine or metal powders.

Finally, some **corrosives can rupture storage containers** due to chemical reaction or pressure build up.

4. Controlling Exposure to Corrosives

The best way to reduce or avoid the hazards associated with corrosives is to **substitute** a less hazardous material. In metal cleaning operations for example, chromic acid which is very toxic and corrosive, can sometimes be substituted with special cleaners containing less hazardous ingredients. If substitution is impossible, **engineering controls** such as ventilation must be used. Well designed and maintained ventilation systems will remove corrosive dusts, mists, vapours and gases and reduce hazard of inhalation or skin and eye contact. Ventilation combined with proper storage, handling and disposal of corrosive materials can reduce the health and safety risks.

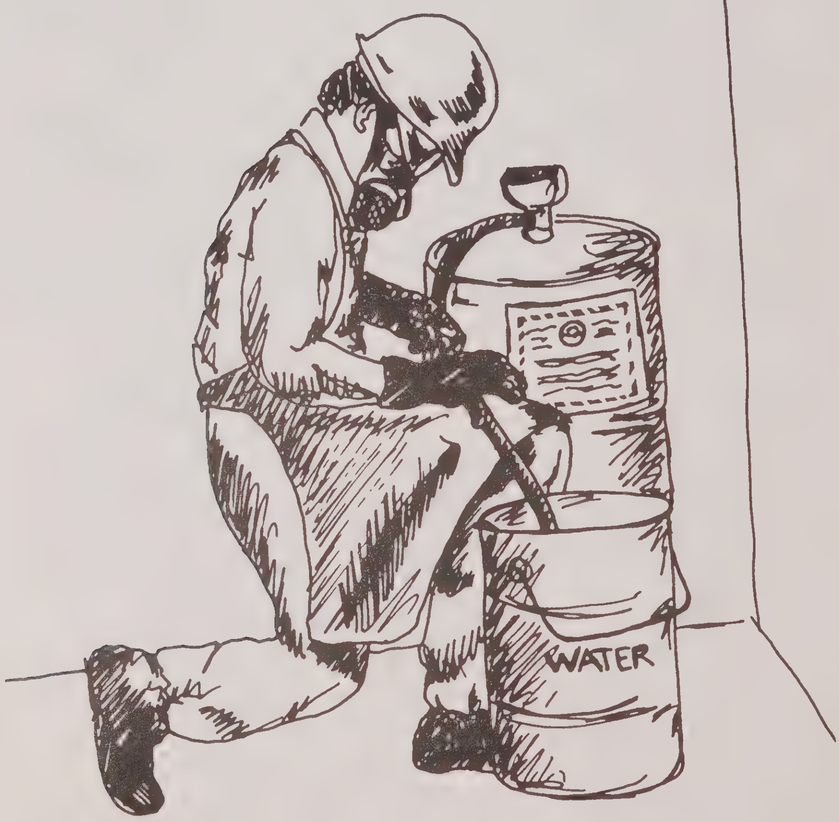
Storage

Proper corrosive storage is extremely important. Corrosives must be kept in undamaged, properly labelled and approved containers. They must be stored separately from all other chemicals and away from production areas. All areas where corrosives are stored should be well ventilated, dry and

cool. The inventory of corrosives should be kept to a minimum. Containers must be periodically vented to avoid bursting or rupturing.

Handling

Always use safe handling procedures. Dip parts slowly into containers or tanks containing corrosives to prevent splashes. Mix all corrosives slowly. Always add corrosive to water (not vice versa). Add in small quantities at a time and mix frequently.



When transferring corrosives from one container to another, dispense from only one container at a time. Whenever possible use drum pumps to transfer corrosives to reduce the chance of splash.

Specially designed safety carriers should be used when moving containers filled with corrosives. Always make sure that containers of corrosives are kept tightly closed when not in use.

Disposal

All waste containers must be made from corrosive resistant material and must be clearly labelled. When disposing of corrosives, do not mix wastes. Mixing of acids and bases or corrosives with other chemicals is hazardous. Never dispose of corrosives down sinks or drains that connect to sanitary or storm sewers.

Personal Protective Equipment

Personal protective equipment must be worn if there is any chance of skin or eye contact with corrosive, or inhalation of corrosive gas, fume, vapours or mist is possible.

For eye protection wear chemical splash goggles, full face shield or full face respirator.

For skin protection use gloves, gauntlets, aprons and boots made of suitable material. Rubber gloves will not protect your skin against chromic acid. Polyethylene gloves should be used for protection against this corrosive.

For respiratory protection wear an appropriate respirator, which is approved for corrosives.

Remember that all personal protective equipment must be of suitable type, in good condition and properly worn.

Always check the Material Safety Data Sheet section on preventive measures for information on personal protective equipment.

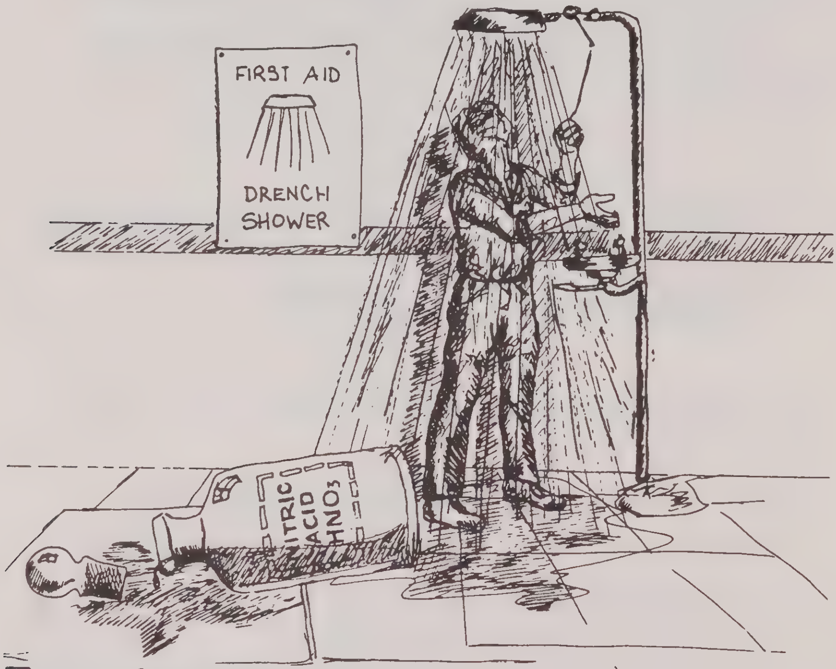
5. What To Do in an Emergency involving Corrosives

In emergencies like chemical fires, leaks and spills, act fast.

- Report the problem to the people responsible for handling emergencies.
- Alert other people in the area and evacuate the area at once.
- Only specially trained people equipped with proper tools and protective equipment should handle the emergency.
- Obtain first aid if you have been exposed to corrosives.

For eyes:
- flush eyes with water for 15 - 20 min.,
- seek medical attention immediately,

For skin contact:
- remove clothing, flush exposed skin with water for 15 - 20 min.,
- seek medical attention



For inhalation:
- remove victim to fresh air,
- if necessary perform artificial respiration,
- seek medical attention

For ingestion:
- do not induce vomiting,
- obtain medical help

Review Questionnaire

1. Circle the WHMIS corrosive symbol.

A.  B.  C.  D.  E. 

2. What is a corrosive material ?

____

____

3. List 2 health hazards of corrosives in case of skin contact and inhalation.

Skin Contact:

1. ______________________________

2. ______________________________

Inhalation:

1. ______________________________

2. ______________________________

4. Which of the following statements are true ?

Acid and bases must be stored separately.	T	F
All areas where corrosives are stored should be well ventilated, dry and cool.	T	F
The storage drums should be vented once a year.	T	F
Safety glasses are suitable for eye protection against corrosives.	T	F
Information on personal protective equipment can be found in MSDS.	T	F
When mixing acid and water, add acid to water.	T	F

5. Circle the least common cause of acid drum ruptures.

(a) heat build up chemical vapour pressure

(b) air pressure used to empty the drum made it burst

(c) the drum fell off a lift truck

(d) the drum was filled with chemicals that differed from those originally in it

(e) chemicals in the drum reacted with the metal forming a hydrogen mixture which ignited

(f) the drum was filled too full, pressure built up and burst it

(g) all of the above

6. Circle what you would do first in case of a corrosive spill.

(a) put personal protective equipment on and clean up the spill

(b) evacuate the area and call for help

(c) alert other workers and proceed to absorb the spill

(d) evacuate the area and wash up the spill with plenty of water

APPENDIX 'A'

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WHMIS

RIGHT TO KNOW

CLASS F

DANGEROUSLY REACTIVE MATERIAL

September, 1988

MODULE F — PARTICIPANT'S GUIDE

TERMINAL OBJECTIVE:

The participant will have a basic knowledge of the hazards of dangerously reactive materials so that they will be able to reduce the risk of injury or damage when working with them.

PERFORMANCE OBJECTIVES:

The participant will:

a) **Recognize** and describe the Class F symbol on the label.

b) **Explain** the basic hazards of dangerously reactive materials.

c) **Describe** principles of safe handling, use, storage, and disposal of dangerously reactive materials.

d) **Explain** how to react in a safe manner to an emergency involving dangerously reactive materials.

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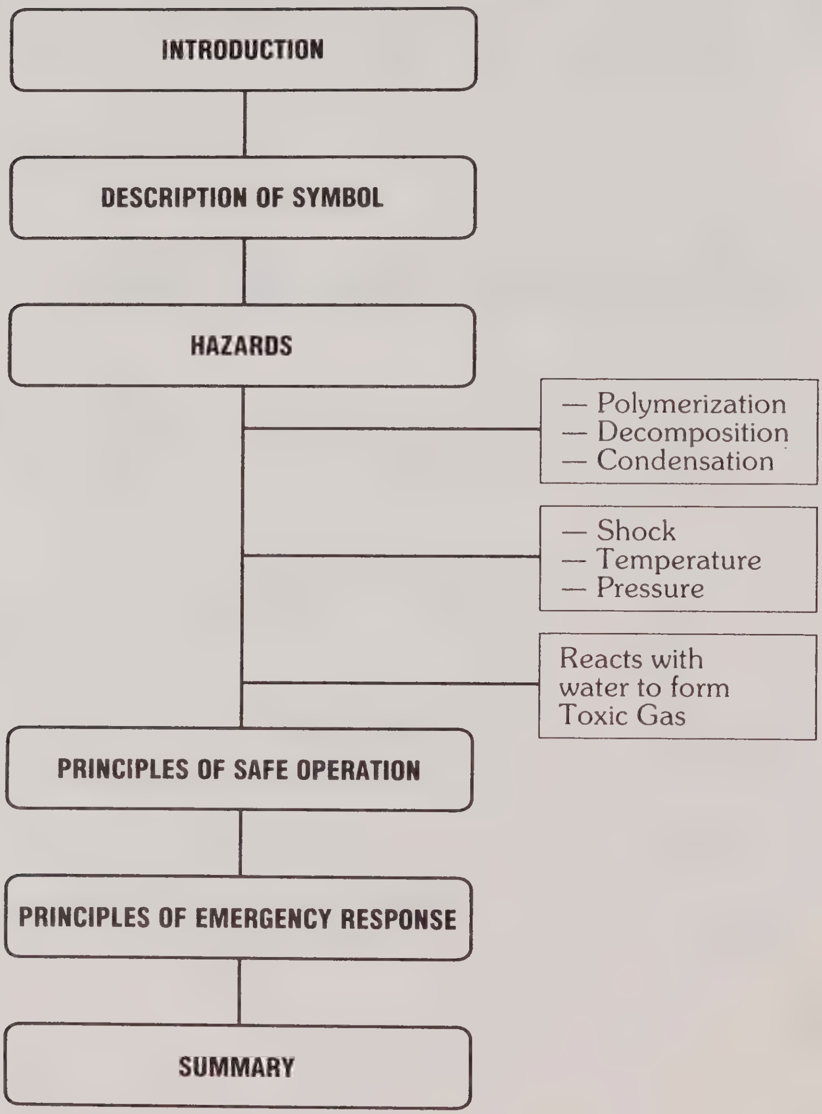

INTRODUCTION
DESCRIPTION OF SYMBOL
HAZARDS
— Polymerization
— Decomposition
— Condensation
— Shock
— Temperature
— Pressure
Reacts with water to form Toxic Gas
PRINCIPLES OF SAFE OPERATION
PRINCIPLES OF EMERGENCY RESPONSE
SUMMARY

DANGEROUSLY REACTIVE MATERIAL

Under the Workplace Hazardous Materials Information System, WHMIS, you have the right to know the hazards of materials you work with, how they can affect your health, and how to protect yourself. This guide will help you to work safely with dangerously reactive material. It provides the basic resource material to be used during the training session and it can be used as a handy reference guide after the program.

This booklet has been prepared to help you recognize and understand:

a) What are Dangerously Reactive Materials?

b) The Hazard Symbol of dangerously reactive materials.

c) The hazards of dangerously reactive materials.

d) Precautionary measures when working with dangerously reactive materials.

e] Principles of emergency response when working with dangerously reactive materials.

This booklet cannot cover every possible handling and use situation. You should recognize what the symbol on the label means, know what is on the Material Safety Data Sheet (MSDS), and know how to apply that information when working with Dangerously Reactive Materials.

1] What are Dangerously Reactive Materials?

A material is classified as dangerously reactive if it:

a) reacts vigorously with water to release a toxic gas, or

b) becomes self-reactive under conditions of shock or increase in pressure or temperature

c) undergoes vigorous polymerization, decomposition or condensation.

Note: There are some materials which are not classified as dangerously reactive but may result in a dangerous reaction when stored with other materials, e.g.

acids and bases. These materials are classified as Class B–Section 6, Flammable and Combustible Materials.

2. Hazard Symbol

The hazard symbol for Dangerously Reactive Materials on a label is a picture of a test tube with sparks coming out of it with a large "R" around the tube enclosed in a circle.

Dangerously Reactive Materials are used in the manufacturing of plastics, in metallurgy, water purification, testing laboratories, and at home in the form of cleaners, cleansers, and detergents.

It is important for you to **recognize the reactive properties** of a substance especially in situations where these products may be shaken up, pressurized, or be exposed to water, heat, or air. Reactive materials can be extremely hazardous if not handled properly. They can undergo a chemical change that can cause explosion or release of toxic gas. The speed with which a chemical reaction takes place is directly related to the movement of the molecules involved. An increase of temperature by increasing the speed of the movement also makes collision more certain. Another condition, an increase in the concentration of the reactive substances, also causes frequent collisions of molecules. Any increased molecular collision rate causes a chemical reaction to proceed more rapidly.

Why is this information necessary to the person handling dangerously reactive material? It helps in predicting and preparing for situations in which dangerously reactive materials are exposed to heat and/or increased pressure.

3) The Hazards of Dangerously Reactive Materials

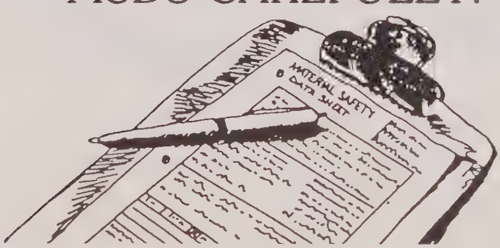
To know how to handle these dangerously reactive materials safely you should know what the hazards are. These hazardous chemicals are placed in the following groups:

a) **Unstable chemicals** which undergo:

- hazardous polymerization
- hazardous decomposition
- hazardous condensation
- self-reaction with shock, or increases in temperature or pressure

b) **Water reactive chemicals,** which are capable of producing toxic gas when mixed with water.

READ THE LABEL AND MSDS CAREFULLY!



What is Polymerization?

Most polymers are formed in two ways, addition or condensation. Addition is a chemical reaction in which two or more small molecules (monomers) continue to combine to form larger molecules (polymers) that contain the same or similar structure as the original small molecules in a long chain.

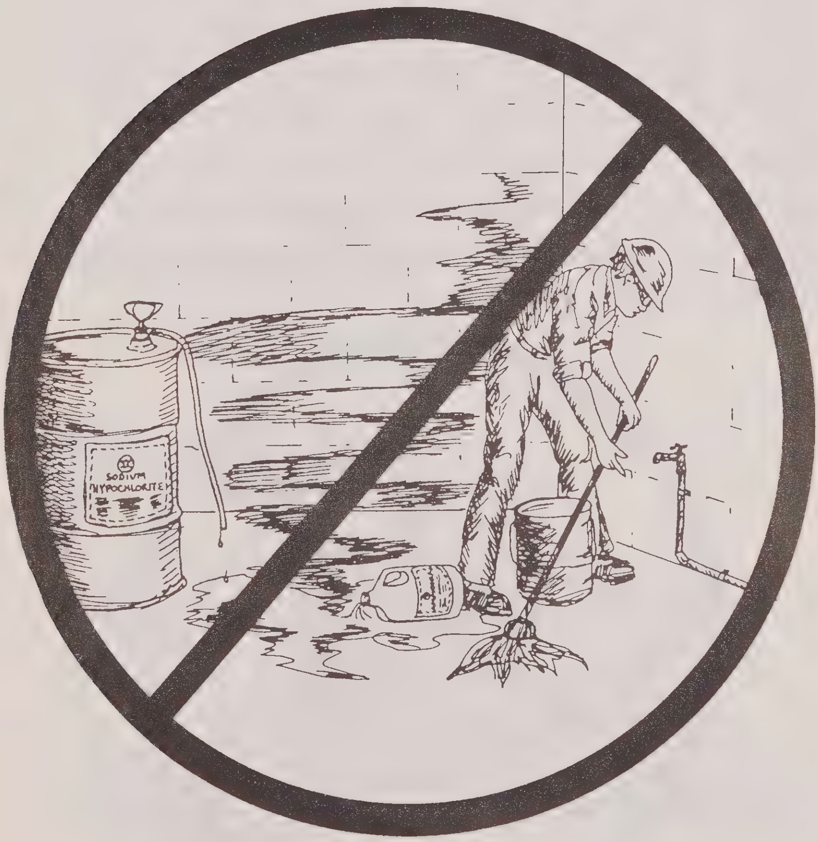
An example of the addition form of polymerization would be a monomer ethylene combining with other ethylene monomers to form polyethylene (plastic bags).

Condensation is the combination of two different units (monomers) with the elimination of a small molecule, usually water, or ammonia to form the polymer. An example would be the forming of a polyester, such as Dacron or nylon by the condensation of a diacid with a dialcohol.

These reactions become hazardous when they are rapidly speeded up which then creates an uncontrolled release of energy.

Some examples of chemicals which can undergo hazardous polymerization are:

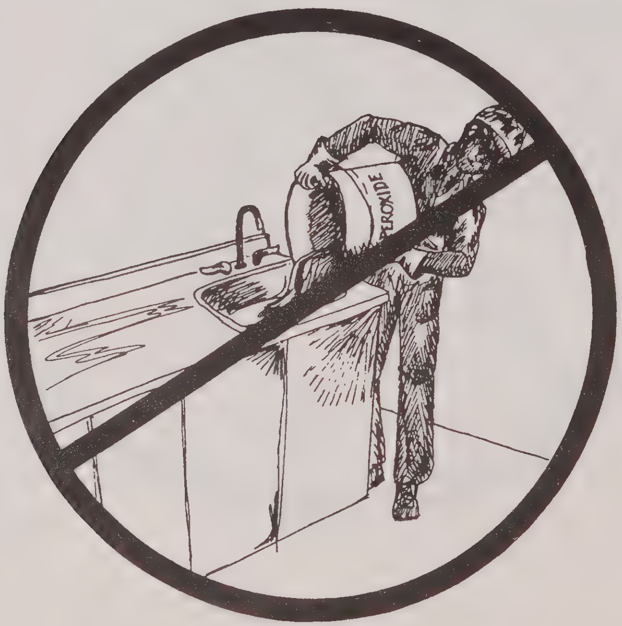
- Ethyl acrylate
- Methyl acrylate
- Styrene
- Vinyl chloride



What is Decomposition?

This is a breakdown of a chemical substance into different parts or simpler compounds. Decomposition can be hazardous because it can create toxic products or a release of energy which can cause explosion.

Decomposition can occur due to heat, chemical reaction, decay, water, etc. Many organic peroxides can be decomposed by heat, shock, or friction. Methyl ethyl ketone peroxide used in fibrous glass work-up is one chemical which can explode violently when exposed to other organic peroxides, or high heat.

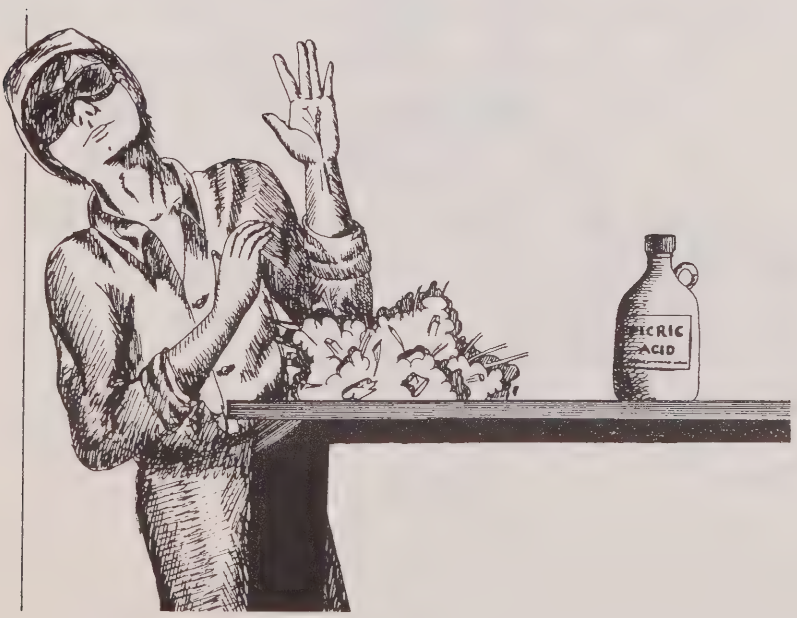


Other chemicals that may undergo potentially hazardous decomposition are:

- Nitromethane
- Organic peroxides
  e.g. Benzoyl peroxide and ether peroxides

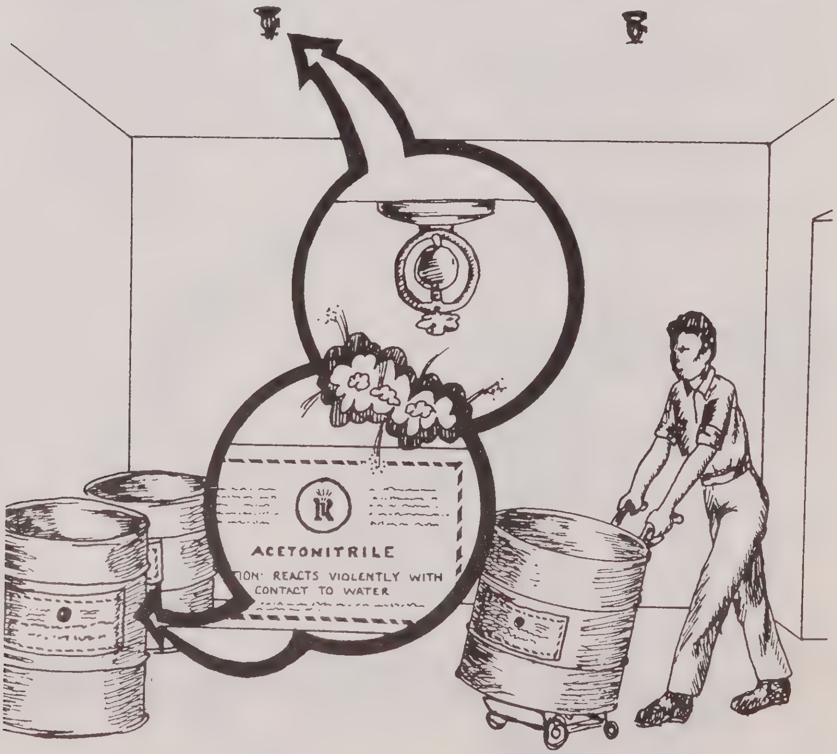
What are self-reactive chemicals?
These are substances which can violently self-react with shock or increases in temperature or pressure. Some examples are:

- Nitromethane
- Nitroglycerine
- Picric Acid



What are water reactive substances?
Second to air, water is the most common substance likely to come into contact, deliberately or by accident, with reactive chemicals. Some of the substances which may react violently, even with small amounts of water to produce a toxic gas are:

- aluminum chloride
- acetonitrile
- acrylonitrile



4) Principles of Handling Dangerously Reactive Chemicals

a) Before handling **read** all the information on the label and the MSDS for that substance.

b) **Follow** your company's safe operating procedures.

c) **Isolate** reactive chemicals. Store compounds of a class together, away from other classes.

d) **Have** plenty of water available for flushing where water sensitive chemicals are not involved.

e) For water sensitive chemicals, **do not allow** water in the storage area, or water type fire extinguishers and sprinklers.

f) Whenever possible **use** chemicals with added inhibitors (substances that will slow down or stop the reaction).

g) **Store** reactive chemicals in a cool, dry area, protect from sunlight, and label with expiry date.

h] **Protect** reactive chemicals, especially explosives, from shock.

i] **Wear** appropriate personal protective equipment where specified.

j] **Have** appropriate pressure release vents and explosion venting in storage areas and reaction vessels.

5. Principles of Emergency Response

a) **Have** antidotes, neutralizers, fire-fighting equipment and trained personnel close by in case of an emergency.

b) **Have** medical assistance available near those areas using reactive chemicals.

c) **Follow** your company's emergency response procedures.

d) Qualified **firefighters should be** made **aware** of the fire and explosion potential in areas where reactive chemicals are handled.

Review Questionnaire

1. Which of the following conditions apply to a dangerously reactive material? Check all responses that apply.

   a) ____ Reacts with water to release a toxic gas.

   b) ____ Forms a polymer.

   c) ____ Becomes self-reactive under conditions of shock or increases in pressure or temperature.

   d) ____ Undergoes rapid decomposition.

   e) ____ Is flammable.

   f) ____ Undergoes rapid polymerization or condensation.

2. Please indicate whether each statement is true or false.

Addition, which is one method of polymerization, is a chemical reaction in which small monomers combine to form larger polymers in a long chain. T F

Decomposition is a breakdown of a chemical into simpler compounds. T F

An example of condensation is a process of changing water into steam. T F

Important information on reactive materials can be found in the reactivity data section of the MSDS. T F

Reactive chemicals are hazardous only at high temperatures. T F

Inhibitors are used to decrease the reactive properties of some chemicals. T F

3. List three principles of storing reactive chemicals.

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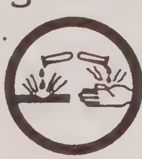
4. Which of the following is the symbol for dangerously reactive materials?

a. 
b. 
c. 
d. 
e. 

CASE STUDY

TANK RUPTURE

An organic material was being **nitrated** with straight nitric acid. At the end of the nitration, the agitator was stopped, the material in the reactor was allowed to settle, and the heavy layer of nitric acid was drawn off the bottom and transferred by a pump to an overhead holding tank. After several washes to remove any residual nitric acid, a secondary alcohol was added to dissolve the nitrated material. The next step was to transfer this alcohol solution by the pump to another portion of the plant for further treatment. In this case, **the valve to the nitric acid holding tank** instead of the valve to the transfer line was opened, thus pumping some of this alcohol solution into the nitric acid. The reaction in the nitric acid tank was **so vigorous** that the two-inch rupture disk which was opened was unable to handle the released gases and a 16-inch diameter manhole cover on the side of this 1200 litre cylindrical tank was blown off. The manhole cover was blown

through the roof and travelled through the air for approximately 150 metres. The tank itself travelled in the other direction destroying a heat exchanger and various pieces of piping. A good portion of the roof and side walls of this building were removed.

The supervisor and the employees of the building had warning that gases were escaping at high velocity through the two-inch vent line of this tank and were evacuating the building when the blast occurred. Their personal injuries were minor scrapes and scratches.

As a table group, answer the following questions concerning this incident.

1) List three reasons why this incident happened.

2) List three preventive measures that can be taken so this incident will not happen again.

APPENDIX 'A'

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